REMARKS

Claims 1-24 are pending in the present application.

In the Office Action, claims 1, 3, 6-11, 13 and 16-20 are rejected under 35 U.S.C. 102(e) as anticipated by US 6,552,763 to Kouya (Kouya).

Reconsideration and withdrawal of the rejections is respectfully requested. Applicants submit the attached Declaration under 37 C.F.R. 1.131 to show that they made the presently claimed invention before September 22, 2000, which is the effective date of Kouya. A certified copy of prior Japanese application No. 2000-115657 (JP'657) filed on April 17, 2001 by the present inventors, a verified English translation of JP'657, and a marked-up copy of the present application showing the changes with respect to JP'657, are attached with the Declaration.

It is noted that JP'657 lists Senri Yoshikawa as an inventor whereas the present application lists Senri Kondou as an inventor because Ms. Yoshikawa changed her name to Senri Kondou due to marriage after the filing date of JP'657, as stated in the Declaration.

Further, the Declaration establishes that the inventors were in possession of the presently claimed invention and had reduced the invention to practice before September 22, 2000. In particular, passages of JP'657 that provide support for the present claims are listed in the Declaration. Reference is also made to the Examples of JP'657. Accordingly, Kouya is removed as a reference against the presently claimed invention.

In view of the above, it is submitted that the rejections should be withdrawn.

In conclusion, the invention as presently claimed is patentable. It is believed that the claims are in allowable condition and a notice to that effect is earnestly requested.

In the event there is, in the Examiner's opinion, any outstanding issue and such issue may be resolved by means of a telephone interview, the Examiner is respectfully requested to contact the undersigned attorney at the telephone number listed below.

In the event this paper is not considered to be timely filed, the Applicants hereby petition for an appropriate extension of the response period. Please charge the fee for such extension and any other fees which may be required to our Deposit Account No. 50-2866.

Respectfully submitted,

WESTERMAN, HATTORI, DANIELS & ADRIAN, LLP

Nicolas Seckel

Nicolas E. Seckel
Attorney for Applicants
Reg. No. 44,373

Atty. Docket No. 020586
1250 Connecticut Avenue NW Suite 700
Washington, D.C. 20036
Tel: (202) 822-1100
Fax: (202) 822-1111
Customer No.: 38834
NES:rep

Encls.: Petition for one-month extension of time
Declaration under Rule 1.131
Certified copy of JP 2000-115657 (JP'657)
Verified English translation of JP'657
Marked-up copy of present application showing changes with respect to JP'657

OIPE JC109 NOV 17 2003 PATENT & TRADEMARK OFFICE

Atty. Docket: 020586

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re the Application of:

Eiji HAMAMOTO et al. | Confirmation No.: 5817

Serial Number: 09/981,614 | Group Art Unit: 2812

Filed: October 16, 2001 | Examiner: LINDSAY JR, WALTER LEE

For: METHOD OF PRODUCING POLARIZING PLATE, AND LIQUID CRYSTAL DISPLAY COMPRISING THE POLARIZING PLATE

DECLARATION UNDER 37 CFR 1.131

RECEIVED
NOV 28 2003
TC 2800 MAIL ROOM

Honorable Commissioner of Patents
P.O. Box 1450
Alexandria, VA 22313-1450

Sir:

We, Eiji HAMAMOTO, Youichirou SUGINO, Kazuki TSUCHIMOTO, Senri KONDOU (formerly Senri YOSHIKAWA), and Seiichi KUSUMOTO, all citizens of Japan, hereby declare and state:

1. Credentials

We are the named inventors in the above-identified application.

2. Purpose of this Declaration

A purpose of this Declaration is to show that the invention claimed in the present application was made before September 22, 2000, which is the filing date of U.S. patent No. 6,552,763 to Kouya (**Kouya**), so that **Kouya** is not prior art under 35 U.S.C. 102(a) or (e) in the present application.

3. Showing of Facts

The showing of facts made in the present Declaration is based on prior Japanese application No. 2000-115657 (**JP'657**), which was filed in the Japanese Patent Office on April 17, 2000 in the name of the inventors in the present application. A certified copy of **JP'657** and a verified English translation of **JP'657** (the **JP'657** translation) are attached to this

Declaration. Priority of **JP'657** is not claimed under the Paris Convention in the present application because the present application was filed on October 16, 2001, which is more than one year after the filing date of **JP'657**.

The undersigned declare that they are the named inventors in the present application and in **JP'657**, and that they are familiar with the invention, **JP'657** and the present application.

Further, the undersigned declare that the invention claimed in the present application was made by the inventors before April 17, 2000. In support of this declaration, a copy of **JP'657** accompanied with a verified English translation of **JP'657** are submitted, which shows that the inventors had conceived and reduced to practice the presently claimed invention before April 17, 2000.

Specifically, the disclosure in **JP'657** is substantially identical to the disclosure in the present application. Differences are shown in the attached marked-up copy of the present specification showing the changes with respect to the **JP'657** translation. Support for the claims in the present U.S. application is found in **JP'657** as follows, reference being made to the **JP'657** translation:

?? Claim 1, 11: paragraph 0006, 0027

?? Claim 2, 12: paragraph 0008

?? Claim 3, 13: paragraph 0012

?? Claims 4-5, 14-15: paragraphs 0014, 0018

?? Claims 6-10, 16-20: paragraph 0027

?? Claims 21-24: paragraph 0058 (Table 1)

JP'657 was filed in the name of the present inventors Eiji HAMAMOTO, Youichirou SUGINO, Kazuki TSUCHIMOTO, Senri KONDOU (formerly Senri YOSHIKAWA), and Seiichi KUSUMOTO, as shown in the opening pages of the **JP'657** translation. Ms. Senri YOSHIKAWA changed her name to Senri KONDOU due to marriage after the filing date of **JP'657**.

Thus, in **JP'657**, the present inventors described the subject matter of the present invention substantially as claimed in the claims of the present application. Therefore, **JP'657** evidences that the present inventors were in possession of the present invention as claimed in

the present application before April 17, 2000.

In addition, in the specification of **JP'657**, the present inventors reported experimental results substantially identically as the experimental results reported in the present specification. Therefore, the experimental results reported in **JP'657** evidence that the present inventors had reduced to practice the invention claimed in the present application before April 17, 2000.

4. Conclusion

The disclosure in **JP'657** evidences that the inventors in the present application were in possession of the invention claimed in the present application before the effective date of **Kouya**. As a result, **Kouyia** is not prior art as to the presently claimed invention.

The undersigned declare that all statements made herein of his/her own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under § 1001 of Title 18 of the United States Code and that willful false statements may jeopardize the validity of the application or any patent issued thereon.

Signed this 21th day of October, 2003 — Eiji Hamamoto
Eiji HAMAMOTO

Signed this 10th day of October, 2003 — Youichirou Sugino
Youichirou SUGINO

Signed this 22th day of October, 2003 — Kazuki Tsuchimoto
Kazuki TSUCHIMOTO

Signed this 16th day of October, 2003 — Senri Kondou
Senri KONDOU

Signed this 30th day of October, 2003 — Seiichi Kusumoto
Seiichi KUSUMOTO

Attachments: Certified Copy of JP 2000-115657
Verified English Translation of JP 2000-115657
Marked-Up Copy of Present Specification Showing Changes with Respect to JP 2000-115657

日本国特許庁
JAPAN PATENT OFFICE

別紙添付の書類に記載されている事項は下記の出願書類に記載されている事項と同一であることを証明する。

This is to certify that the annexed is a true copy of the following application as filed with this Office.

出願年月日
Date of Application: ２０００年 ４月１７日

出願番号
Application Number: 特願２０００－１１５６５７

[ST. 10/C] : ［ＪＰ２０００－１１５６５７］

出願人
Applicant(s): 日東電工株式会社

２００３年 ９月２２日

特許庁長官
Commissioner,
Japan Patent Office 今井康夫

出証番号 出証特２００３－３０７７６８４

【書類名】　特許願
【整理番号】　R4006
【提出日】　平成12年 4月17日
【あて先】　特許庁長官　殿
【国際特許分類】　G09F　9/00　306
G09F　9/00　322
G09F　9/00　331
G02B　5/30
G02F　1/1335 510
【発明者】
【住所又は居所】　大阪府茨木市下穂積１丁目１番２号　日東電工株式会社内
【氏名】　濱本　英二
【発明者】
【住所又は居所】　大阪府茨木市下穂積１丁目１番２号　日東電工株式会社内
【氏名】　杉野　洋一郎
【発明者】
【住所又は居所】　大阪府茨木市下穂積１丁目１番２号　日東電工株式会社内
【氏名】　土本　一喜
【発明者】
【住所又は居所】　大阪府茨木市下穂積１丁目１番２号　日東電工株式会社内
【氏名】　吉川　せんり
【発明者】
【住所又は居所】　大阪府茨木市下穂積１丁目１番２号　日東電工株式会社内
【氏名】　楠本　誠一

【特許出願人】
【識別番号】　000003964
【氏名又は名称】　日東電工株式会社
【代理人】
【識別番号】　100095555
【弁理士】
【氏名又は名称】　池内　寛幸
【電話番号】　06-6361-9334
【選任した代理人】
【識別番号】　100076576
【弁理士】
【氏名又は名称】　佐藤　公博
【手数料の表示】
【予納台帳番号】　012162
【納付金額】　21,000円
【提出物件の目録】
【物件名】　明細書　1
【物件名】　要約書　1
【包括委任状番号】　9005971
【プルーフの要否】　要

【書類名】　明細書
【発明の名称】　偏光板の製造方法及び液晶表示装置
【特許請求の範囲】

【請求項１】透過率３５％以上、偏光度９０％以上の偏光子の製造方法であって、前記偏光子の片面又は両面に、保護層として貼り合わせる時の偏光子の水分率が、５％～３０％であることを特徴とする偏光板の製造方法。
（ただし、偏光子の水分率の測定方法は、貼り合せ前の偏光子重量（Ａ）と、その偏光子を、１２０℃の乾燥機に7時間入れた後の偏光子重量（Ｂ）より、
偏光子の水分率（%）＝［（Ａ－Ｂ）／Ｂ］×１００で求める。）

【請求項２】延伸軸方向に垂直な方向の表面粗さが、中心線平均粗さに基づいて０．０４μm以下である請求項１に記載の偏光板の製造方法。

【請求項３】請求項１または２に記載の方法によって製造された偏光板に、反射板または半透過反射板を貼り合せ、反射型偏光板または半透過反射板型偏光板を形成する偏光板の製造方法。

【請求項４】請求項１または２に記載の方法によって製造された偏光板に、位相差板またはλ板を貼り合せ、楕円または円偏光板を形成する偏光板の製造方法。

【請求項５】請求項１または２に記載の方法によって製造された偏光板に、視角補償フィルム貼り合せ、偏光板を形成する偏光板の製造方法。

【請求項６】請求項１または２に記載の方法によって製造された偏光板に、接着剤または粘着剤を用いて輝度向上フィルム貼り合せ、偏光板を形成する偏光板の製造方法。

【請求項７】請求項１～６に記載の方法によって製造された偏光板を液晶セルの少なくとも片側に備えた液晶表示装置。

【発明の詳細な説明】

【０００１】

【発明の属する技術分野】

本発明は、液晶表示装置（以下、ＬＣＤと略称することがある。）に使用する偏光板の製造方法とこれにより得られた偏光板を備えた液晶表示装置に関する。

さらに詳しくは、保護層の表面に偏光フィルムの延伸に起因するレコードの溝状の凹凸が発生せず、反射で見ても反射像が鮮明で、外観上の問題を改善した偏光板の製造方法及び液晶表示装置に関する。

【０００２】

【従来の技術】

ＬＣＤは、パソコン等に使用されており、近年、急激に増加している。ＬＣＤの用途は広がってきており、近年モニター用途にも使用される様になってきている。

【０００３】

偏光板は、ＰＶＡフィルムを二色性を有するヨウ素又は染料で染色した後、ほう酸やほう砂等で架橋して偏光板を作製する。尚、染色工程および架橋工程にて一軸延伸を行うが、この延伸は工程中に行ってもよいし、その工程の前後にて行ってもよい。染色工程および架橋工程の後、通常、乾燥機等を用いて乾燥し、接着剤を用いてトリアセチルセルロース（ＴＡＣ）フィルム等の保護層と貼り合わせて製造される。

【０００４】

ところで液晶表示装置に用いる偏光板は、透過率と偏光度を共に高くすることが要請されている。偏光板の透過率と偏光度を共に高くするためには、偏光板の原材料であるＰＶＡ（ポリビニルアルコール）フィルムの延伸倍率を高くする必要がある。しかし、ＰＶＡの延伸倍率を高くすると、偏光子の表面にレコードの溝状の凹凸が延伸方向に発生しやすくなり、外観上好ましくない。また、このレコードの溝状の凹凸は、保護層として貼り合わせるＴＡＣやポリエチレンテレフタレート（ＰＥＴ）等のフィルム部にも影響して、保護層の上からでもレコードの溝状の凹凸が発生するため、反射で見ると、反射像がぼやけて見えるため、外観上問題となっている。

【０００５】

【発明が解決しようとする課題】

本発明は、前記従来の問題を解決するため、保護層の表面に偏光フィルムの延伸に起因するレコードの溝状の凹凸が発生せず、反射で見ても反射像が鮮明で、

外観上の問題を改善した偏光板の製造方法及び液晶表示装置を提供することを目的とする。

【０００６】

【課題を解決するための手段】

前記目的を達成するため本発明の偏光板の製造方法は、透過率３５％以上、偏光度９０％以上の偏光子の製造方法であって、前記偏光子の片面又は両面に、保護層として貼り合わせる時の偏光子の水分率が、５％～３０％であることを特徴とする（ただし、偏光子の水分率の測定方法は、貼り合せ前の偏光子重量（Ａ）と、その偏光子を、１２０℃の乾燥機に７時間入れた後の偏光子重量（Ｂ）より、偏光子の水分率（％）＝［（Ａ－Ｂ）／Ｂ］×１００で求める。）。偏光子の水分率が5％未満では、偏光子が硬くなり、レコードの溝上の凸凹が発生し、さらに、偏光子中より架橋剤が析出し易くなり外観欠点も多くなるという問題がある。また水分率が30％を越えると水分が高くなり、ＴＡＣ等の保護層との貼り合せで接着不良が発生し易くなったり、ＴＡＣ貼り合わせ後の乾燥処理により、偏光板面内にヨウ素の脱色によるムラが発生するという不都合がある。

【０００７】

前記において、偏光子の水分率のさらに好ましい範囲は、９～２７％である。

【０００８】

前記方法においては、延伸軸方向に垂直な方向の表面粗さが、中心線平均粗さに基づいて０．０４μｍ以下であることが好ましい。０．０４μｍを越えると、目視によるムラの確認が容易になる。つまりムラが目立ち易くなる。

【０００９】

本発明においては、前記の方法によって製造された偏光板に、反射板または半透過反射板を貼り合せ、反射型偏光板または半透過反射板型偏光板を形成することもできる。

【００１０】

また前記の方法によって製造された偏光板に、位相差板またはλ板を貼り合せ、楕円または円偏光板を形成することもできる。

【００１１】

また前記の方法によって製造された偏光板に、視角補償フィルム貼り合せ、偏光板を形成することもできる。

【００１２】

また前記の方法によって製造された偏光板に、接着剤または粘着剤を用いて輝度向上フィルム貼り合せ、偏光板を形成することもできる。

【００１３】

次に本発明の液晶表示装置は、前記の方法によって製造された偏光板を液晶セルの少なくとも片側に備えたことを特徴とする。

【００１４】

【発明の実施の形態】

本発明の偏光板の製造工程において、偏光板の原材料であるＰＶＡフィルムを、膨潤、染色、延伸、架橋、乾燥等の工程を経て偏光機能を有する偏光子が得られその後、その偏光子に接着剤又は、粘着剤を用いて、ＴＡＣや、ＰＥＴ等のフィルムを保護層として貼り合せて、偏光板を得る。

【００１５】

偏光子の製造工程において、膨潤、染色、延伸、架橋の４工程は、工程の順番は、特に規定されるものではなく、また、４工程を、２～４工程を同時に行っても、一向に構わない。

【００１６】

本発明においては、偏光子や偏光板に発生するレコードの溝状の凹凸の発生をなくす方法として、偏光子と保護層を貼り合わせる時の、偏光子の水分率を、５％～３０％にすることによって、偏光板に発生する、レコードの溝状の凹凸を解決することができた。

【００１７】

尚、一般的には、ＰＶＡフィルムを膨潤、染色、延伸、架橋、乾燥等して、得られる偏光子は、一旦ロール状に巻き取る為、その後、その偏光子を加湿等によって偏光子の水分率を調湿した後、ＴＡＣフィルム等の保護層に貼り合せる連続生産方式でおこなうことも可能である。

【００１８】

偏光膜の製造方法は、一般的にＰＶＡフィルムを、２色性の特性をもつヨウ素または、染料の入った浴中にて、染色する「染色工程」と、ほう酸や、ほう砂等のＰＶＡの架橋剤の入った浴中にて、架橋する「架橋工程」と、ＰＶＡの延伸を行う「延伸工程」の３工程に大別できる。なお、「延伸工程」は、通常「染色工程」および「架橋工程」と同時に行われることが多いが、別工程にて行ってもよい。また、染色工程と架橋工程も同時に行ってもよい。偏光膜は、上記３工程の後、乾燥を行い、保護層となる、トリアセチルセルロース（ＴＡＣ）フィルムや、ポリエチレンテレフタレート（ＰＥＴ）フィルム等のフィルムを片側又は、両側に貼り合わせて製造される。

【００１９】

偏光子（偏光フイルム）としては、例えばポリビニルアルコールや部分ホルマール化ポリビニルアルコールなどの従来に準じた適宜なビニルアルコール系ポリマーよりなるフィルムにヨウ素や二色性染料等よりなる二色性物質による染色処理や延伸処理や架橋処理等の適宜な処理を適宜な順序や方式で施してなり、自然光を入射させると直線偏光を透過する適宜なものを用いうる。とくに、光透過率や偏光度に優れるものが好ましい。

【００２０】

偏光子（偏光フィルム）の片側又は両側に設ける透明保護層となる保護フィルム素材としては、適宜な透明フィルムを用いうる。そのポリマーの例としてトリアセチルセルロースの如きアセテート系樹脂が一般的に用いられるが、これに限定されるものではない。

【００２１】

偏光特性や耐久性などの点より、特に好ましく用いうる透明保護フィルムは、表面をアルカリなどでケン化処理したトリアセチルセルロースフィルムである。なお偏光フィルムの両側に透明保護フィルムを設ける場合、その表裏で異なるポリマー等からなる透明保護フィルムを用いてもよい。

【００２２】

保護層に用いられる透明保護フイルムは、本発明の目的を損なわない限り、ハードコート処理や反射防止処理、スティッキングの防止や拡散ないしアンチグレ

ア等を目的とした処理などを施したものであってもよい。ハードコート処理は、偏光板表面の傷付き防止などを目的に施されるものであり、例えばシリコーン系などの適宜な紫外線硬化型樹脂による硬度や滑り性等に優れる硬化皮膜を透明保護フィルムの表面に付加する方式などにて形成することができる。

【００２３】

一方、反射防止処理は偏光板表面での外光の反射防止を目的に施されるものであり、従来に準じた反射防止膜などの形成により達成することができる。またスティッキング防止は隣接層との密着防止を目的に、アンチグレア処理は偏光板の表面で外光が反射して偏光板透過光の視認を阻害することの防止などを目的に施されるものであり、例えばサンドブラスト方式やエンボス加工方式等による粗面化方式や透明微粒子の配合方式などの適宜な方式にて透明保護フィルムの表面に微細凹凸構造を付与することにより形成することができる。

【００２４】

前記の透明微粒子には、例えば平均粒径が０．５～２０μmのシリカやアルミナ、チタニアやジルコニア、酸化錫や酸化インジウム、酸化カドミウムや酸化アンチモン等が挙げられ、導電性を有する無機系微粒子を用いてもよく、また、架橋又は未架橋のポリマー粒状物等からなる有機系微粒子などを用いうる。透明微粒子の使用量は、透明樹脂１００重量部あたり２～７０重量部、とくに５～５０重量部が一般的である。

【００２５】

透明微粒子配合のアンチグレア層は、透明保護層そのものとして、あるいは透明保護層表面への塗工層などとして設けることができる。アンチグレア層は、偏光板透過光を拡散して視角を拡大するための拡散層（視角補償機能など）を兼ねるものであってもよい。なお上記した反射防止層やスティッキング防止層、拡散層やアンチグレア層等は、それらの層を設けたシートなどからなる光学層として透明保護層とは別体のものとして設けることもできる。

【００２６】

本発明において偏光子（偏光フィルム）と保護層である透明保護フィルムとの接着処理は、特に限定されるものではないが、例えば、ビニルアルコール系ポリ

マーからなる接着剤、あるいは、ホウ酸やホウ砂、グルタルアルデヒドやメラミン、シュウ酸などのビニルアルコール系ポリマーの水溶性架橋剤から少なくともなる接着剤などを介して行うことができる。かかる接着層は、水溶液の塗布乾燥層などとして形成しうるが、その水溶液の調製に際しては必要に応じて、他の添加剤や、酸等の触媒も配合することができる。

【００２７】

本発明による偏光板は、実用に際して他の光学層と積層した光学部材として用いることができる。その光学層については特に限定はないが、例えば反射板や半透過反射板、位相差板（１／２波長板、１／４波長板などのλ板も含む）、視角補償フィルムや輝度向上フィルムなどの、液晶表示装置等の形成に用いられことのある適宜な光学層の１層又は２層以上を用いることができ、特に、前述した本発明の偏光子と保護層からなる偏光板に、更に反射板または、半透過反射板が積層されてなる反射型偏光板または半透過反射板型偏光板、前述した本発明の偏光子と保護層からなる偏光板に、更に位相差板が積層されている楕円または、円偏光板、前述した本発明の偏光子と保護層からなる偏光板に、更に視角補償フィルムが積層されている偏光板、あるいは、前述した本発明の偏光子と保護層からなる偏光板に、更に輝度向上フィルムが積層されている偏光板が好ましい。

【００２８】

前記の反射板について説明すると、反射板は、それを偏光板に設けて反射型偏光板を形成するためのものであり反射型偏光板は、通常液晶セルの裏側に設けられ、視認側（表示側）からの入射光を反射させて表示するタイプの液晶表示装置などを形成でき、バックライト等の光源の内蔵を省略できて液晶表示装置の薄型化をはかりやすいなどの利点を有する。

【００２９】

反射型偏光板の形成は、必要に応じ上記した透明保護フィルム等を介して偏光板の片面に金属等からなる反射層を付設する方式などの適宜な方式にて行うことができる。ちなみにその具体例としては、必要に応じマット処理した透明保護フィルムの片面に、アルミニウム等の反射性金属からなる箔や蒸着膜を付設して反射層を形成したものなどが挙げられる。

【００３０】

また微粒子を含有させて表面微細凹凸構造とした上記の透明保護フィルムの上にその微細凹凸構造を反映させた反射層を有する反射型偏光板などもあげられる。表面微細凹凸構造の反射層は、入射光を乱反射により拡散させて指向性やギラギラした見栄えを防止し、明暗のムラを抑制しうる利点などを有する。透明保護フィルムの表面微細凹凸構造を反映させた微細凹凸構造の反射層の形成は、例えば真空蒸着方式、イオンプレーティング方式、スパッタリング方式等の蒸着方式やメッキ方式などの適宜な方式で金属を透明保護フィルムの表面に直接付設する方法などにより行うことができる。

【００３１】

また反射板は、上記した偏光板の透明保護フィルムに直接付設する方式に代えて、その透明保護フィルムに準じた適宜なフィルムに反射層を設けてなる反射シートなどとして用いることもできる。反射板の反射層は、通常、金属からなるので、その反射面がフィルムや偏光板等で被覆された状態の使用形態が、酸化による反射率の低下防止、ひいては初期反射率の長期持続の点や、保護層の別途付設の回避の点などから好ましい。

【００３２】

なお半透過型偏光板は、上記において反射層を光を反射し、かつ透過するハーフミラー等の半透過型の反射層とすることにより得ることができる。半透過型偏光板は、通常液晶セルの裏側に設けられ、液晶表示装置などを比較的明るい雰囲気で使用する場合には、視認側（表示側）からの入射光を反射させて画像を表示し、比較的暗い雰囲気においては、半透過型偏光板のバックサイドに内蔵されているバックライト等の内蔵光源を使用して画像を表示するタイプの液晶表示装置などを形成できる。すなわち、半透過型偏光板は、明るい雰囲気下では、バックライト等の光源使用のエネルギーを節約でき、比較的暗い雰囲気下においても内蔵光源を用して使用できるタイプの液晶表示装置などの形成に有用である。

【００３３】

次に、前述した本発明の偏光子と保護層からなる偏光板に、更に位相差板が積層されている楕円または、円偏光板について説明する。

【００３４】
直線偏光を楕円または、円偏光に変えたり、楕円または、円偏光を直線偏光に変えたり、あるいは直線偏光の偏光方向を変える場合に、位相差板などが用いられ、特に、直線偏光を楕円または、円偏光に変えたり、楕円または、円偏光を直線偏光に変える位相差板としては、いわゆる１／４波長板（λ／４板とも言う）が用いられる。１／２波長板（λ／２板とも言う）は、通常、直線偏光の偏光方向を変える場合に用いられる。

【００３５】
楕円偏光板は、ＳＴＮ形液晶表示装置の液晶層の複屈折によって生じた着色（青又は黄）を補償して、前記着色のない白黒表示にする場合などに有効に用いられる。更に、3次元の屈折率を制御したものは、液晶表示装置の画面を斜め方向から見た際に生じる着色も補償（防止）することができ好ましい。円偏光板は、例えば画像がカラー表示になる反射型液晶表示装置の画像の色調を整える場合などに有効に用いられ、また、反射防止の機能も有する。

【００３６】
ちなみに前記位相差板の具体例としては、ポリカーボネートやポリビニルアルコール、ポリスチレンやポリメチルメタクリレート、ポリプロピレンやその他のポリオレフィン、ポリアリレートやポリアミドの如き適宜なポリマーからなるフィルムを延伸処理してなる複屈折性フィルムや液晶ポリマーの配向フィルム、液晶ポリマーの配向層をフィルムにて支持したものなどがあげられる。また傾斜配向フィルムとしては、例えばポリマーフィルムに熱収縮性フィルムを接着して加熱によるその収縮力の作用下にポリマーフイルムを延伸処理又は／及び収縮処理したものや液晶ポリマーを斜め配向させたものなどがあげられる。

【００３７】
次に、前述した本発明の偏光子と保護層からなる偏光板に、更に視角補償フィルムが積層されている偏光板について説明する。

【００３８】
視角補償フィルムは、液晶表示装置の画面を画面に垂直でなく、やや斜めの方向から画面を見た場合でも、画像が比較的鮮明に見えるように視角を広げるため

のフィルムである。

【００３９】

このような視角補償フィルムとしては、トリアセチルセルロースフィルムなどにディスコティック液晶を塗工したものや、位相差板が用いられる。通常の位相差板がその面方向に一軸に延伸された複屈折を有するポリマーフィルムが用いられるのに対し、視角補償フィルムとして用いられる位相差板は、面方向に二軸に延伸された複屈折を有するポリマーフィルムとか、面方向に一軸に延伸され厚さ方向にも延伸された厚さ方向の屈折率を制御した傾斜配向ポリマーフィルムのような２方向延伸フィルムなどが用いられる。傾斜配向フィルムとしては、前述したように、例えばポリマーフィルムに熱収縮性フィルムを接着して加熱によるその収縮力の作用下にポリマーフイルムを延伸処理又は／及び収縮処理したものや液晶ポリマーを斜め配向させたものなどがあげられる。位相差板の素材原料ポリマーは、先の位相差板で説明したポリマーと同様のものが用いられる。

【００４０】

前述した本発明の偏光子と保護層からなる偏光板に、輝度向上フィルムを貼り合わせた偏光板は、通常液晶セルの裏側サイドに設けられて使用される。輝度向上フィルムは、液晶表示装置などのバックライトや裏側からの反射などにより自然光が入射すると所定偏光軸の直線偏光又は所定方向の円偏光を反射し、他の光は透過する特性を示すもので、輝度向上フィルムを前述した偏光子と保護層とからなる偏光板と積層した偏光板は、バックライト等の光源からの光を入射させて所定偏光状態の透過光を得ると共に、前記所定偏光状態以外の光は透過せずに反射される。この輝度向上フィルム面で反射した光を更にその後ろ側に設けられた反射層等を介し反転させて輝度向上板に再入射させ、その一部又は全部を所定偏光状態の光として透過させて輝度向上フイルムを透過する光の増量を図ると共に、偏光子に吸収されにくい偏光を供給して液晶画像表示等に利用しうる光量の増大を図ることにより輝度を向上させうるものである。すなわち、輝度向上フイルムを使用せずに、バックライトなどで液晶セルの裏側から偏光子を通して光を入射した場合には、偏光子の偏光軸に一致していない偏光方向を有する光はほとんど偏光子に吸収されてしまい、偏光子を透過してこない。すなわち、用いた偏光

子の特性にもよっても異なるが、およそ５０％の光が偏光子に吸収されてしまい、その分、液晶画像表示等に利用しうる光量が減少し、画像が暗くなる。輝度向上フイルムは、偏光子に吸収される様な偏光方向を有する光を偏光子に入射させずに輝度向上フイルムで一旦反射させ、更にその後ろ側に設けられた反射層等を介し反転させて輝度向上板に再入射させることを繰り返し、この両者間で反射、反転している光の偏光方向が偏光子を通過し得るような偏光方向になった偏光を輝度向上フイルムは、透過させ、偏光子に供給するので、バックライトなどの光りを効率的に液晶表示装置の画像の表示に使用でき、画面を明るくすることができるのである。

【００４１】

前記の輝度向上フィルムとしては、例えば誘電体の多層薄膜や屈折率異方性が相違する薄膜フィルムの多層積層体の如き、所定偏光軸の直線偏光を透過して他の光は反射する特性を示すもの、コレステリック液晶層、就中コレステリック液晶ポリマーの配向フィルムやその配向液晶層をフィルム基材上に支持したものの如き、左回り又は右回りのいずれか一方の円偏光を反射して他の光は透過する特性を示すものなどの適宜なものを用いうる。

【００４２】

従って前記した所定偏光軸の直線偏光を透過するタイプの輝度向上フィルムでは、その透過光をそのまま偏光板に偏光軸を揃えて入射させることにより偏光板による吸収ロスを抑制しつつ効率よく透過させることができる。一方、コレステリック液晶層の如く円偏光を透過するタイプの輝度向上フィルムでは、そのまま偏光子に入射させることもできるが、吸収ロスを抑制する点よりはその透過円偏光を位相差板を介し直線偏光化して偏光板に入射させることが好ましい。ちなみにその位相差板として１／４波長板を用いることにより、円偏光を直線偏光に変換することができる。

【００４３】

可視光域等の広い波長範囲で１／４波長板として機能する位相差板は、例えば波長５５０ｎｍの光等の単色光に対して１／４波長板として機能する位相差層と他の位相差特性を示す位相差層、例えば１／２波長板として機能する位相差層と

を重畳する方式などにより得ることができる。従って偏光板と輝度向上フィルムの間に配置する位相差板は、１層又は２層以上の位相差層からなるものであってよい。

【００４４】

なおコレステリック液晶層についても、反射波長が相違するものの組合せにして２層又は３層以上重畳した配置構造とすることにより、可視光域等の広い波長範囲で円偏光を反射するものを得ることができ、それに基づいて広い波長範囲の透過円偏光を得ることができる。

【００４５】

なお、本発明の偏光板は、上記した偏光分離型偏光板の如く偏光板と２層又は３層以上の光学層とを積層したものからなっていてもよい。従って上記の反射型偏光板や半透過型偏光板と位相差板を組合せた反射型楕円偏光板や半透過型楕円偏光板などであってもよい。２層又は３層以上の光学層を積層した光学部材は、液晶表示装置等の製造過程で順次別個に積層する方式にても形成しうるものであるが、予め積層して光学部材としたものは、品質の安定性や組立作業性等に優れて液晶表示装置などの製造効率を向上させうる利点がある。なお積層には、粘着層等の適宜な接着手段を用いうる。

【００４６】

本発明による偏光板や光学部材には、液晶セル等の他部材と接着するための粘着層を設けることもできる。その粘着層は、アクリル系等の従来に準じた適宜な粘着剤にて形成することができる。就中、吸湿による発泡現象や剥がれ現象の防止、熱膨張差等による光学特性の低下や液晶セルの反り防止、ひいては高品質で耐久性に優れる液晶表示装置の形成性などの点より、吸湿率が低くて耐熱性に優れる粘着層であることが好ましい。また微粒子を含有して光拡散性を示す粘着層などとすることもできる。粘着層は必要に応じて必要な面に設ければよく、例えば、本発明の偏光子と保護層からなる偏光板の保護層について言及するならば、必要に応じて、保護層の片面又は両面に粘着層を設ければよい。

【００４７】

偏光板や光学部材に設けた粘着層が表面に露出する場合には、その粘着層を実

用に供するまでの間、汚染防止等を目的にセパレータにて仮着カバーすることが好ましい。セパレータは、上記の透明保護フィルム等に準じた適宜な薄葉体に、必要に応じシリコーン系や長鎖アルキル系、フッ素系や硫化モリブデン等の適宜な剥離剤による剥離コートを設ける方式などにより形成することができる。

【００４８】

なお上記の偏光板や光学部材を形成する偏光フィルムや透明保護フィルム、光学層や粘着層などの各層は、例えばサリチル酸エステル系化合物やベンゾフェノン系化合物、ベンゾトリアゾール系化合物やシアノアクリレート系化合物、ニッケル錯塩系化合物等の紫外線吸収剤で処理する方式などの適宜な方式により紫外線吸収能をもたせたものなどであってもよい。

【００４９】

本発明による偏光板は、液晶表示装置等の各種装置の形成などに好ましく用いることができる。液晶表示装置は、本発明による偏光板を液晶セルの片側又は両側に配置してなる透過型や反射型、あるいは透過・反射両用型等の従来に準じた適宜な構造を有するものとして形成することができる。従って液晶表示装置を形成する液晶セルは任意であり、例えば薄膜トランジスタ型に代表されるアクティブマトリクス駆動型のもの、ツイストネマチック型やスーパーツイストネマチック型に代表される単純マトリクス駆動型のものなどの適宜なタイプの液晶セルを用いたものであってよい。

【００５０】

また液晶セルの両側に偏光板や光学部材を設ける場合、それらは同じものであってもよいし、異なるものであってもよい。さらに液晶表示装置の形成に際しては、例えばプリズムアレイシートやレンズアレイシート、光拡散板やバックライトなどの適宜な部品を適宜な位置に１層又は２層以上配置することができる。

【００５１】

【実施例】

以下実施例及び比較例を用いて本発明をさらに具体的に説明する。

【００５２】

（実施例１）

クラレ製ＰＶＡ（９×７５ＲＳ）を用いて１番目の浴（ヨウ素、ＫＩの水溶液３０℃）で３倍延伸後、２番目の浴（ほう酸、ＫＩ水溶液５５℃）中でトータル延伸倍率で６倍まで延伸して偏光子を得た。その後、乾燥機および加湿機を用いて、温度、湿度、風量、時間を調整し、偏光子の水分率を6%に調整した後、ＴＡＣ（トリアセチルセルロース）フィルムとＰＶＡ系接着剤を用いて貼り合せて偏光板を作製した。

【００５３】

（実施例2）

クラレ製ＰＶＡ（９×７５ＲＳ）を用いて１番目の浴（ヨウ素、ＫＩの水溶液３０℃）で３倍延伸後、２番目の浴（ほう酸、ＫＩ水溶液５５℃）中でトータル延伸倍率で６倍まで延伸して偏光子を得た。その後、乾燥機および加湿機を用いて、温度、湿度、風量、時間を調整し、偏光子の水分率を１５％に調整した後、ＴＡＣ（トリアセチルセルロース）フィルムとＰＶＡ系接着剤を用いて貼り合せて偏光板を作製した。

【００５４】

（実施例3）

クラレ製ＰＶＡ（９×７５ＲＳ）を用いて１番目の浴（ヨウ素、Ｋ１の水溶液３０℃）で３倍延伸後、２番目の浴（ほう酸、ＫＩ水溶液５５℃）中でトータル延伸倍率で６倍まで延伸して偏光子を得た。その後、乾燥機および加湿機を用いて、温度、湿度、風量、時間を調整し、偏光子の水分率を２６％に調整した後、ＴＡＣ（トリアセチルセルロース）フィルムとＰＶＡ系接着剤を用いて貼り合せて偏光板を作製した。

【００５５】

（比較例１）

クラレ製ＰＶＡ（９×７５ＲＳ）を用いて１番目の浴（ヨウ素、ＫＩの水溶液３０℃）で、３倍延伸後、２番目の浴（ほう酸、ＫＩ水溶液５５℃）中でトータル延伸倍率で６倍まで延伸して偏光子を得た。その後、乾燥機および加湿機を用いて、温度、湿度、風量、時間を調整し、偏光子の水分率を4%に調整した後、ＴＡＣ（トリアセチルセルロース）フィルムとＰＶＡ系接着剤を用いて貼り合せ

て偏光板を作製した。

【００５６】

（比較例2）

クラレ製ＰＶＡ（９×７５ＲＳ）を用いて１番目の浴（ヨウ素、ＫＩの水溶液３０℃）で、３倍延伸後、２番目の浴（ほう酸、ＫＩ水溶液５５℃）中でトータル延伸倍率で６倍まで延伸して偏光子を得た。その後、乾燥機および加湿機を用いて、温度、湿度、風量、時間を調整し、偏光子の水分率を35％に調整した後、ＴＡＣ（トリアセチルセルロース）フィルムとＰＶＡ系接着剤を用いて貼り合せて偏光板を作製した。しかし水分率が35％では水分が高いためにＴＡＣとの貼り合せのときの乾燥処理により、偏光板の面内にムラが発生した。

【００５７】

上記実施例1～３および比較例１～２の評価をした。光学特性として、単体の透過率と、偏光度を測定した。偏光板の偏光軸方向（延伸軸方向に垂直方向）表面形状を、（東京精密社製）表面粗さ形状測定機を用いて、中心線平均粗さ（Ｒａ）および凹凸の平均間隔（Ｓｍ）を調べた。また、目視観察によって、スジの有無を確認した。その結果を次の表1に示す。

【００５８】

【表1】

	偏光子の水分率(%)	透過率(%)	偏光率(%)	表面凸凹の測定		目視判定
				Ra(μm)	Sm(mm)	
比較例１	4	43.8	99.95	0.08	0.75	強いスジ有り
実施例１	6	43.8	99.95	0.03	1.81	うすいスジ
実施例２	１５	43.8	99.94	0.01以下	測定不能	スジなし
実施例３	２６	43.8	99.95	0.01以下	測定不能	スジなし
比較例２	３５	43.8	99.90	0.01以下	測定不能	スジなし

（備考）比較例２はスジはなかったが面内のムラが発生した。

【００５９】

表1から明らかなとおり、本発明の実施例２～3は、表面粗さの中心線平均粗さ（Ｒａ）は小さく、凹凸の平均間隔（Ｓｍ）は測定不能であり、目視観察による

判定では、スジはなかった。実施例１は薄い筋が目視でわずかに確認できたが、実用上は問題なかった。

【００６０】

これに対して比較例1は湿度条件が本発明の範囲外であったので、表面粗さの中心線平均粗さ（Ｒａ）は粗く、凹凸の平均間隔（Ｓｍ）も大きく、目視観察による判定ではスジ有りであった。比較例２は表面粗さの中心線平均粗さ（Ｒａ）及び凸凹の平均間隔（Ｓｍ）は良好であったが光学特性の偏光度が悪くなり、さらに面内にムラが見られ、外観上好ましくなかった。

【００６１】

【発明の効果】

以上説明のとおり、本発明の偏光板の製造方法は、透過率３５％以上、偏光度９０％以上の偏光子の製造方法であって、前記偏光子の片面又は両面に、保護層として貼り合わせる時の偏光子の水分率が、５％～３０％であることにより、保護層の表面に偏光フィルムの延伸に起因するレコードの溝状の凹凸が発生せず、反射で見ても反射像が鮮明で、外観上の問題を改善した偏光板の製造方法及び液晶表示装置を提供できる。

【書類名】　要約書

【要約】

【課題】保護層の表面に偏光フィルムの延伸に起因するレコードの溝状の凹凸が発生せず、反射で見ても反射像が鮮明で、外観上の問題を改善した偏光板の製造方法及び液晶表示装置を提供する。

【解決手段】透過率３５％以上、偏光度９０％以上の偏光子を得る際に、偏光子の片面又は両面に、保護層として貼り合わせる時の偏光子の水分率を５％～３０％の範囲とする（ただし、偏光子の水分率の測定方法は、貼り合せ前の偏光子重量（Ａ）と、その偏光子を、１２０℃の乾燥機に７時間入れた後の偏光子重量（Ｂ）より、偏光子の水分率（％）＝［（Ａ－Ｂ）／Ｂ］×１００で求める。）。

【選択図】なし

特願２０００－１１５６５７

出　願　人　履　歴　情　報

識別番号　　　　　　　［０００００３９６４］

１．変更年月日　　　　１９９０年　８月３１日
　　［変更理由］　　　新規登録
　　　　住　所　　　　大阪府茨木市下穂積１丁目１番２号
　　　　氏　名　　　　日東電工株式会社

Verification of Translation

US Patent Application Serial No. 09/981,614

TITLE OF THE INVENTION: METHOD OF PRODUCING POLARIZING PLATE, AND LIQUID CRYSTAL DISPLAY COMPRISING THE POLARIZING PLATE

I, Yoshie HAGA, professional patent translator, whose full post office address is IKEUCHI・SATO & PARTNER PATENT ATTORNEYS, 26th Floor, OAP Tower 8-30, Tenmabashi 1-Chome, Kita-ku, Osaka-shi 530-6026, Japan, am the translator of the documents attached and I state that the following is a true translation to the best of my knowledge and belief of JP 2000-115657 A (R4006).

At Osaka, Japan
DATED this October 3, 2003

Signature of the translator

Yoshie Haga

Yoshie HAGA

JAPAN PATENT OFFICE

This is to certify that the annexed is a true copy of the following application as filed with this Office.

Date of Application:	April 17, 2000
Application Number:	Patent Application No. 2000-115657
[ST. 10/C]:	[JP2000-115657]
Applicant(s):	Nitto Denko Corporation

September 22, 2003
Commissioner, Japan Patent Office: Yasuo IMAI

[Document Name]	Patent Application
[Case Number]	R4006
[Date of Application]	April 17, 2000
[Destination]	Director–General of the Japanese Patent Office

[Intern. Patent Classification] G09F 9/00 306
G09F 9/00 322
G09F 9/00 331
G02B 5/30
G02F 1/1335 510

[Inventor]
[Address] c/o Nitto Denko Corporation, 1-2, Shimohozumi 1-chome, Ibaraki-shi, Osaka
[Name] Eiji HAMAMOTO
[Inventor]
[Address] c/o Nitto Denko Corporation, 1-2, Shimohozumi 1-chome, Ibaraki-shi, Osaka
[Name] Youichirou SUGINO
[Inventor]
[Address] c/o Nitto Denko Corporation, 1-2, Shimohozumi 1-chome, Ibaraki-shi, Osaka
[Name] Kazuki TSUCHIMOTO
[Inventor]
[Address] c/o Nitto Denko Corporation, 1-2, Shimohozumi 1-chome, Ibaraki-shi, Osaka
[Name] Senri YOSHIKAWA
[Inventor]
[Address] c/o Nitto Denko Corporation, 1-2, Shimohozumi 1-chome, Ibaraki-shi, Osaka
[Name] Seiichi KUSUMOTO
[Patent Applicant]
[Identification Number] 000003964
[Name/Title] Nitto Denko Corporation
[Attorney]
[Identification Number] 100095555

[Patent Attorney]
[Name] Hiroyuki IKEUCHI
[Telephone Number] 06–6361–9334
[Appointed Attorney]
[Identification Number] 100076576
[Patent Attorney]
[Name] Kimihiro SATO
[Indication of Official Fees]
[Deposit Account Number] 012162
[Amount of Deposit] 21000
[List of File Documents]
[Name of Document] Patent Specification 1
[Name of Document] Abstract 1
[General Power of Attorney Number] 9005971
[Proof] Required

[Document Name] SPECIFICATION

[TITLE OF THE INVENTION] METHOD OF PRODUCING POLARIZING PLATE, AND LIQUID CRYSTAL DISPLAY

[CLAIMS]

[Claim 1] A method of producing a polarizer having transmittance of at least 35% and a polarization degree of at least 90%, and a method of producing a polarizing plate comprising a polarizer whose moisture content is in a range from 5% to 30% when a protective layer is bonded to at least one surface of the polarizer,
(where a measurement value is obtained by a calculation based on an equation of moisture content (%) = $[(A - B) / B] \times 100$, when A denotes weight of the polarizer before bonding and B denotes weight of the polarizer after being kept in a dryer of 120°C for seven hours).

[Claim 2] The method of producing a polarizing plate according to claim 1, wherein surface roughness of the polarizing plate in a direction perpendicular to the stretching direction is 0.04 μm or less on the basis of the centerline average roughness.

[Claim 3] A method of producing a polarizing plate, wherein a reflecting plate or a semitransparent reflecting plate is bonded to a polarizing plate produced according to the method of claim 1 or 2 so as to form a reflective polarizing plate or a semitransparent reflective polarizing plate.

[Claim 4] A method of producing a polarizing plate, wherein a retardation plate or a λ plate is bonded to a polarizing plate produced according to the method of claim 1 or 2 so as to form an elliptically-polarizing plate or a circularly-polarizing plate.

[Claim 5] A method of producing a polarizing plate, wherein a viewing angle compensating plate or a λ plate is bonded to a polarizing plate produced according to the method of claim 1 or 2 so as to form a polarizing plate.

[Claim 6] A method of producing a polarizing plate, wherein a brightness-enhanced film is bonded by using either an adhesive or a pressure-sensitive adhesive to a polarizing plate produced according to the method of claim 1 or 2 so as to form a polarizing plate.

[Claim 7] A liquid crystal display comprising a polarizing plate produced according to a method of any of claims 1-6 and provided to at least one surface of a liquid crystal cell.

[DETAILED DESCRIPTION OF THE INVENTION]

[0001]

[Technical field the invention pertains]

The present invention relates to the field of polarizing plates for a liquid crystal display (LCD) and a liquid crystal display using polarizing plates. More specifically, the present invention provides a method of producing a polarizing plate having an improved appearance and also a liquid crystal display comprising the polarizing plate. In this context, "improved appearance" means that a protective layer of the polarizing plate substantially has no irregularities like grooves on a record caused by stretching of a polarizing film bonded to the protective layer. Such a polarizing plate can provide clear images even when reflected light is applied.

[0002]

[Prior art]

Recently, the use of LCDs in personal computers (PCs) or the like has increased sharply, and they have been used for monitors as well.

[0003]

Typical polarizing plates used for display devices such as LCDs are produced from polyvinyl alcohol (PVA) films or the like. The PVA films are dyed with dichroic iodine or dichroic dyestuff, and then crosslinked with boric acid, borax or the like. The films are then stretched uniaxially. The stretching step can be included in the dyeing and/or crosslinking steps. Alternatively, the film can be stretched before and/or after the dyeing and/or crosslinking steps. In general, the film is dried in a dryer or the like after the dyeing and crosslinking steps, and it is bonded to a protective layer such as a triacetylcellulose (TAC) film through an adhesive.

[0004]

A polarizing plate used for a LCD is required to have high transmittance and a high polarization degree. For this purpose, a PVA film should be stretched at a high ratio. However, when a PVA film is stretched at a high stretch ratio, irregularities like grooves on a record may be generated on the polarizer surface, and this will impair the appearance. The irregularities can be recognized even through a protective film like a TAC film or a polyethylene terephthalate (PET) film bonded to the polarizer. As a result, images provided by the polarizing plate will be blurred when reflected light is applied.

[0005]

[Problem to be solved by the invention]

The present invention provides a method of producing a polarizing plate having an improved appearance and also a liquid crystal display comprising the polarizing plate. In this context, "improved appearance" means that a protective layer of the polarizing plate substantially has no irregularities like grooves on a record caused by stretching of a polarizing film bonded to the protective layer. Such a polarizing plate can provide clear images even when reflected light is applied.

[0006]

[Means for solving problem]

In a method of producing a polarizing plate according to the present invention, a protective layer is bonded to at least one surface of a polarizer so as to provide a polarizer having transmittance of at least 35% and a polarization degree of at least 90%. This method is characterized in that moisture content of the polarizer is in a range from 5% to 30% during a step that the protective layer is bonded to the polarizer. (A measurement value is obtained by a calculation based on an equation of moisture content (%) = $[(A - B) / B] \times 100$, when A denotes weight of the polarizer before bonding and B denotes weight of the polarizer after being kept in a dryer of 120°C for seven hours.) When the moisture content is less than 5%, the polarizer becomes hard. This causes irregularities like record grooves on the surface, and a crosslinking agent tends to be deposited from the polarizer so as to deteriorate the appearance. Moisture content over 30% will cause some disadvantages such as adhesion failure when the polarizer is bonded to a protective layer such as a TAC film. Moreover, irregularities occur due to discoloring of iodine in the polarizing plate during a drying treatment subsequent to bonding of the TAC film.

[0007]

A further preferred range for the moisture content of the polarizer is from 9% to 27%.

[0008]

The surface roughness of the polarizing plate in a direction perpendicular to the stretching direction plate is at most 0.04 μm on the basis of the centerline average roughness. When the roughness exceeds 0.04 μm, visual recognition of irregularities may be facilitated. That is, irregularities will be prominent.

[0009]

In one embodiment, the polarizing plate can be either a reflective or a semitransparent reflective polarizing plate obtained by bonding either a reflecting plate or a semitransparent reflecting plate onto any of the above-mentioned polarizing plates.

[0010]

In one embodiment, the polarizing plate can be obtained by bonding a retardation plate or a λ plate onto any of the above-mentioned polarizing plates so as to cope with either elliptically or circularly polarized light.

[0011]

In one embodiment, the polarizing plate can be obtained by bonding a viewing angle compensating film onto any of the above-mentioned polarizing plates.

[0012]

In one embodiment, the polarizing plate can be obtained by bonding a brightness-enhanced film onto any of the above-mentioned polarizing plates by using an adhesive or a pressure-sensitive adhesive.

[0013]

A liquid crystal display according to the present invention comprises a liquid crystal cell and a polarizing plate prepared in the above-mentioned process, and the polarizing plate is provided to at least one surface of the liquid crystal cell.

[0014]

[Mode for carrying out the invention]

According to a method of producing a polarizing plate, a polarizer having a polarizing function is obtained by subjecting a PVA film to respective steps such as swelling, dyeing, stretching, crosslinking and drying. Later, the polarizer is bonded to a protective film of TAC, PET or the like through an adhesive or a pressure-sensitive adhesive so as to provide a polarizing plate.

[0015]

There is no specific limitation on the order of four steps of swelling, dyeing, stretching and crosslinking. Some or all of the four steps can be performed simultaneously.

[0016]

In the present invention, irregularities like record grooves on the polarizer or on the polarizing plate can substantially be prevented by

limiting the moisture content of the polarizer in a range from 5% to 30% during a step of bonding the polarizer and the protective layer.

[0017]

Generally, a polarizer of a PVA film, which is processed through steps including swelling, dyeing, stretching, crosslinking and drying, is wound into a roll for the following steps. Such a polarizer can be produced in a continuous series of steps including adjustment of the moisture content of the polarizer by humidification or the like, before bonding the polarizer to a protective layer such as a TAC film.

[0018]

A typical process of producing a polarizing film comprises three steps of dyeing, crosslinking and stretching. In a dyeing step, a PVA film is dyed in a bath containing dichroic iodine or dyestuff. In a crosslinking step, the film is crosslinked in a bath containing a PVA-crosslinking agent such as boric acid and borax. In a stretching step, the PVA film is stretched. Stretching is often performed simultaneously with the dyeing and crosslinking steps, but it can be carried out separately. Alternatively, the dyeing step and the crosslinking step can be performed at the same time. Subsequent to the three steps, the PVA film is dried and then, a protective layer such as a TAC film or a PET film is bonded to at least one surface of the PVA film.

[0019]

In one embodiment, a polarizer (polarizing film) is prepared from a conventional film comprising a suitable vinyl alcohol-based polymer such as polyvinyl alcohol and partially formalized polyvinyl alcohol. The film is treated in a suitable order and a suitable process, for example, dyeing with a dichroic substance selected from, e.g., iodine and dichroic dyestuff, stretching and crosslinking. A preferable polarizer will transmit linearly polarized light when natural light enters. It is more preferable that the polarizer has excellent optical transmittance and polarization degree.

[0020]

Any appropriate transparent film can be used for a protective film to form a transparent protective layer on at least one surface of a polarizer (polarizing film). One typical and non-limiting example of polymers for the protective film is an acetate-based resin such as triacetylcellulose.

[0021]

A transparent protective film preferred especially from the aspect of

polarizing characteristics and durability is a TAC film having a surface saponified with an alkali substance or the like. Transparent protective films formed on both surfaces of a polarizing film are not necessarily made of identical polymers.

[0022]

A transparent protective film used for the protective layer can be treated to provide properties such as hard coating, antireflection, anti-sticking, diffusion and anti-glaring, as long as the purposes of the present invention are not sacrificed. Hard coating treatment is applied, for example, to prevent scratches on the surfaces of the polarizing plate. A surface of the transparent protective film can be applied with a coating film of a cured resin with excellent hardness and smoothness, e.g., a silicone-based ultraviolet-cure type resin.

[0023]

Antireflection treatment may be applied to prevent reflection of outdoor daylight on the surface of the polarizing plate. Such an anti-reflection film or the like can be formed in a known method. Anti-sticking treatment is applied to prevent adherence of adjacent layers. Anti-glare treatment is applied to prevent visibility of light transmitted through the polarizing plate from being hindered by outdoor daylight reflected on the polarizing plate surface. Anti-glare treatment can be carried out by providing microscopic asperity on a surface of a transparent protective film in an appropriate manner, e.g., by roughening the surface by sand-blasting or embossing, or by blending transparent particles.

[0024]

The above-mentioned transparent fine particles will be selected from silica, alumina, titania, zirconia, stannic oxide, indium oxide, cadmium oxide, antimony oxide or the like, and the particles have an average diameter ranging from 0.5 μm to 20 μm. Inorganic fine particles having electroconductivity can be used as well. Alternatively, the particles can be organic fine particles comprising, for example, crosslinked or uncrosslinked polymer particles. An amount of the transparent fine particles ranges from 2 weight parts to 70 weight parts, and generally, from 5 weight parts to 50 weight parts, for 100 weight parts of a transparent resin.

[0025]

An anti-glare layer comprising transparent fine particles can be provided as the transparent protective layer or a coating layer applied onto

a transparent protective layer surface. The anti-glare layer can function as a diffusion layer to diffuse light transmitted through the polarizing plate in order to enlarge visual angles (this function is denoted as visual angle compensation). The above-mentioned layers such as the antireflection layer, the anti-sticking layer, the diffusion layer and the anti-glare layer can be provided as an sheet of optical layers comprising these layers separately from the transparent protective layer.

[0026]

There is no specific limitation on a method to adhere the polarizer (polarizing film) and the transparent protective film. Adhesion can be applied, for example, by using adhesives such as an adhesive comprising vinyl alcohol-based polymer, or an adhesive comprising at least the vinyl alcohol-based polymer and a water-soluble agent to crosslink the vinyl alcohol-based polymer, such as boric acid, borax, glutaraldehyde, melamine and oxalic acid. Such an adhesive layer is formed by, for example, applying and drying an aqueous solution, and an additive or a catalyst such as an acid can be blended in preparation of the aqueous solution if required.

[0027]

A polarizing plate of the present invention can be laminated with another optical layer in order to be used as an optical member. Though there is no specific limitation on the optical layer, one or more suitable optical layer applicable for formation of a liquid crystal display can be used, and the optical layer can be selected from, for example, a reflecting plate, a semitransparent reflecting plate, a retardation plate such as a λ plate like a half wavelength plate and a quarter wavelength plate, a viewing angle compensating film, and a brightness-enhanced film. In a preferred embodiment, a reflective polarizing plate or a semitransparent reflective polarizing plate formed by laminating an additional reflecting plate or a semitransparent reflecting plate on the above-mentioned polarizing plate comprising a polarizer and a protective layer according to the present invention; a polarizing plate formed by laminating an additional retardation plate on the above-mentioned polarizing plate comprising a polarizer and a protective layer; a polarizing plate having a viewing angle compensating film laminated additionally on the above-mentioned polarizing plate comprising a polarizer and a protective layer; and a polarizing plate having a brightness-enhanced film laminated additionally on the above-mentioned polarizing plate comprising a polarizer and a protective layer is used.

[0028]

A reflecting plate is provided to a polarizing plate in order to form a reflective polarizing plate. In general, such a reflective polarizing plate is arranged on a backside of a liquid crystal cell in order to make a liquid crystal display to reflect incident light from a visible side (display side). The reflective polarizing plate has some merits, for example, assembling of light sources such as backlight can be omitted, and the liquid crystal display can be thinned further.

[0029]

The reflective polarizing plate can be formed in an appropriate manner such as attaching a reflecting layer of metal or the like on one surface of the polarizing plate. For example, a transparent protective film is prepared by matting one of the surfaces if required. On this surface, a foil comprising a reflective metal such as aluminum or a deposition film is applied to form a reflecting layer.

[0030]

An additional example of a reflective polarizing plate comprises the above-mentioned transparent protective film having a surface of a microscopic asperity due to contained fine particles, and also a reflecting layer corresponding to the microscopic asperity. The reflecting layer having a microscopic asperity surface diffuses incident light irregularly so that directivity and glare can be prevented and irregularity in color tones can be controlled. This transparent protective film can be formed by attaching a metal directly on a surface of a transparent protective film in any appropriate methods including deposition such as vacuum deposition, and plating such as ion plating and sputtering.

[0031]

Alternatively, the reflecting plate can be used as a reflecting sheet formed by providing a reflecting layer onto a proper film similar to the transparent protective film. Since a typical reflecting layer of a reflecting plate is made of a metal, it is used preferably in a state coated with a film, a polarizing plate or the like in order to prevent the reflection rate from reduction due to oxidation. As a result, the initial reflection rate is maintained for a long period, and a separate protective layer can be omitted.

[0032]

A semitransparent polarizing plate is provided by replacing the reflecting layer in the above-mentioned reflective polarizing plate by a

semitransparent reflecting layer, and it is exemplified by a half mirror that reflects and transmits light at the reflecting layer. In general, such a semitransparent polarizing plate is arranged on a backside of a liquid crystal cell. In a liquid crystal display comprising the semitransparent polarizing plate, incident light from the visible side (display side) is reflected to display an image when a liquid crystal display is used in a relatively bright atmosphere, while in a relatively dark atmosphere, an image is displayed by using a built-in light source such as a backlight in the backside of the semitransparent polarizing plate. In other words, the semitransparent polarizing plate can be used to form a liquid crystal display that can save energy for a light source such as a backlight under a bright atmosphere, while a built-in light source can be used under a relatively dark atmosphere.

[0033]

The above-mentioned polarizing plate comprising a polarizer and a protective layer can have an additional laminate of a retardation plate.

[0034]

The retardation plate is used for modifying linearly polarized light to either elliptically polarized light or circularly polarized light, modifying either elliptically polarized light or circularly polarized light to linearly polarized light, or modifying a polarization direction of linearly polarized light. For example, a retardation plate called a quarter wavelength plate ($\lambda/4$ plate) is used for modifying linearly polarized light to either elliptically polarized light or circularly polarized light, and for modifying either elliptically polarized light or circularly polarized light to linearly polarized light. A half wavelength plate ($\lambda/2$ plate) is used in general for modifying a polarization direction of linearly polarized light.

[0035]

The above-described polarizing plate concerning elliptical polarized light is effective in compensating (preventing) colors (blue or yellow) generated due to birefringence in a liquid crystal layer of a super twist nematic (STN) liquid crystal display so as to provide a black-and-white display free of such colors. Controlling three-dimensional refractive index is preferred further since it can compensate (prevent) colors that will be observed when looking a screen of the liquid crystal display from an oblique direction. A polarizing plate concerning circularly polarized light is effective in adjusting color tones of an image of a reflective liquid crystal

display that has a color image display, and the polarizing plate serves to prevent reflection as well.

[0036]

Specific examples of the retardation plates include birefringent films, oriented films of liquid crystal polymers, sheets comprising film and oriented layers supported by the films, and incline-oriented films. The birefringent films can be prepared by stretching films of any suitable liquid crystal polymers such as polycarbonate, polyvinyl alcohol, polystyrene, polymethyl methacrylate, polyolefins including polypropylene, polyalylate, and polyamide. An incline-oriented film is produced, for example, by bonding a heat shrinkable film onto a polymer film and stretching and/or shrinking the polymer film under an influence of the shrinking force provided by heat, or by orienting obliquely a liquid crystal polymer.

[0037]

A polarizing plate described below comprises the above-mentioned polarizer and protective layer, and further an additional viewing angle compensating film laminated on the polarizing plate.

[0038]

A viewing angle compensating film is used for widen an visual angle so that an image can be clear relatively when a screen of a liquid crystal display is seen not in a direction perpendicular to the screen but in a slightly oblique direction.

[0039]

Such a viewing angle compensating film can be a triacetylcellulose film coated with a discotic liquid crystal, or a retardation plate. While an ordinary retardation plate is a birefringent polymer film that is stretched uniaxially in the face direction, a retardation plate used for an viewing angle compensating film is a two-way stretched film such as a birefringent polymer film stretched biaxially in the face direction and an incline-oriented polymer film with controlled birefringence in the thickness direction that is stretched uniaxially in the face direction and stretched also in the thickness direction. The incline-oriented film is prepared by, for example, bonding a heat shrinkable film to a polymer film and stretching and/or shrinking the polymer film under an influence of shrinkage force provided by heat, or by orienting obliquely a liquid crystal polymer. A polymer as a material of the retardation plate is similar to the polymer used for the above-mentioned retardation plate.

[0040]

A polarizing plate described below is produced by laminating a brightness-enhanced film additionally on the above-mentioned polarizing plate comprising a polarizer and a protective layer. Generally, this polarizing plate is arranged on a backside of a liquid crystal cell. When natural light enters, by reflection from a backlight or a backside of a liquid crystal display etc., the brightness-enhanced film reflects linearly polarized light of a predetermined polarizing axis or circularly polarized light in a predetermined direction while the same film transmits other light. It allows entrance of light from a light source such as a backlight so as to obtain transmitted light in a predetermined polarization state, while reflecting light other than light in the predetermined polarization state. Light that is reflected at this brightness-enhanced film is reversed through a reflecting layer or the like arranged additionally behind the brightness-enhanced film. The reversed light that re-enters the brightness-enhanced plate is transmitted partly or entirely as light in a predetermined polarization state, so that light transmitting the brightness-enhanced film is increased and polarized light that is hardly absorbed in the polarizer is supplied. As a result, quantity of light available for the liquid crystal display etc. can be increased to enhance brightness. When light enters through a polarizer from the backside of a liquid crystal cell by using a backlight or the like without using any brightness-enhanced films, most light is absorbed in the polarizer but not transmitted the polarizer if the light has a polarization direction inconsistent with the polarization axis of the polarizer. Depending on characteristics of the polarizer, about 50% of light is absorbed in the polarizer, and this decreases quantity of light available in the liquid crystal display or the like and makes the image dark. The brightness-enhanced film repeatedly prevents light having a polarization direction to be absorbed in the polarizer from entering the polarizer, and reflects the light on the brightness-enhanced film, reverses the light through a reflecting layer or the like arranged behind, and makes the light re-enter the brightness-enhanced plate. Since the polarized light that is reflected and reversed between them is transmitted only if the light has a polarization direction to pass the polarizer, light from a backlight or the like can be used efficiently for displaying images of a liquid crystal display in order to provide a bright screen.

[0041]

A suitable example of the brightness-enhanced film is selected from a multilayer thin film of a dielectric or a multilayer lamination of thin films with varied refraction aeolotropy that transmits linearly polarized light having a predetermined polarization axis while reflecting other light, and a cholesteric liquid crystal layer, more specifically, an oriented film of a cholesteric liquid crystal polymer or an oriented liquid crystal layer fixed onto a supportive substrate that reflects either clockwise or counterclockwise circularly polarized light while transmitting other light.

[0042]

Therefore, for a brightness-enhanced film to transmit linearly polarized light having a predetermined polarization axis, the transmission light enters the polarizing plate by matching the polarization axis so that absorption loss due to the polarizing plate is controlled and the light can be transmitted efficiently. For a brightness-enhanced film to transmit circularly polarized light, i.e., a cholesteric liquid crystal layer, preferably, the transmission circularly polarized light is converted to linearly polarized light before entering the polarizing plate in an aspect of controlling of the absorption loss, though the circularly polarized light can enter the polarizer directly. Circularly polarized light can be converted to linearly polarized light by using a quarter wavelength plate for a retardation plate.

[0043]

A retardation plate having a function as a quarter wavelength plate in a wide wave range including a visible light region can be obtained, for example, by overlapping a retardation layer functioning as a quarter wavelength plate for monochromatic light such as light having 550 nm wavelength and another retardation plate showing a separate optical retardation property (e.g., a retardation plate functioning as a half wavelength plate). Therefore, a retardation plate arranged between a polarizing plate and a brightness-enhanced film can comprise a single layer or at least two layers of retardation layers.

[0044]

A cholesteric liquid crystal layer also can be provided by combining layers different in the reflection wavelength and it can be configured by overlapping two or at least three layers. As a result, the obtained retardation plate can reflect circularly polarized light in a wide wavelength range including a visible light region, and this can provide transmission

circularly polarized light in a wide wavelength range.

[0045]

A polarizing plate according to the present invention can be made by laminating a polarizing plate and two or at least three optical layers, similarly to the above-described polarization-separation type polarizing plates. In other words, the polarizing plate can be a reflective polarizing plate or a semitransparent polarizing plate for elliptically polarized light, which is prepared by combining either the above-mentioned reflective polarizing plate or a semitransparent polarizing plate with a retardation plate. An optical member comprising a lamination of two or at least three optical layers can be formed in a method of laminating layers separately in a certain order for manufacturing a liquid crystal display etc. Since an optical member that has been laminated previously has excellent stability in quality and assembling operability, efficiency in manufacturing a liquid crystal display can be improved. Any appropriate adhesion means such as a pressure-sensitive adhesive can be used for laminating the polarizing plate and optical layers.

[0046]

A pressure-sensitive adhesive layer can be provided to a polarizing plate or to an optical member in the present invention for adhesion with other members such as a liquid crystal cell. The pressure-sensitive adhesive layer can contain any suitable pressure-sensitive adhesives such as an acrylic adhesive in accordance with conventional techniques. Particularly, pressure-sensitive adhesive layers having a low moisture absorption coefficient and an excellent heat resistance is preferred from the aspect of prevention of foaming or peeling caused by moisture absorption or prevention of decrease in the optical properties and warping of a liquid crystal cell caused by difference in thermal expansion coefficients. As a result, a high quality liquid crystal display having excellent durability can be produced. The pressure-sensitive adhesive layer can include fine particles to obtain optical diffusivity. Pressure-sensitive adhesive layers can be provided to appropriate surfaces if required. For example, a polarizing plate comprising a polarizer and a protective layer can be provided with a pressure-sensitive adhesive layer on at least one surface of the protective layer.

[0047]

When a pressure-sensitive adhesive layer is exposed on a surface of

the polarizing plate or the optical member, preferably, the pressure-sensitive adhesive layer is covered with a separator by the time the pressure-sensitive adhesive layer is used so that contamination will be prevented. The separator can be made of an appropriate thin sheet by coating a peeling agent if required, and the peeling agent may be selected, for example, from a silicone-based agent, a long-chain alkyl-based agent, a fluorine-based agent, an agent comprising molybdenum sulfide or the like.

[0048]

The above-described members composing a polarizing plate and an optical member, such as a polarizer, a transparent protective film, an optical layer and a pressure-sensitive adhesive layer, can have ultraviolet absorption power as a result of treatment with an ultraviolet absorber such as an ester salicylate compound, a benzophenone compound, a benzotriazole compound, a cyanoacrylate compound, and a nickel complex salt compound.

[0049]

Polarizing plates according to the present invention can be used preferably for forming various devices such as LCDs. Such a polarizing plate is arranged on at least one surface of a liquid crystal cell in order to form various devices such as a liquid crystal display. The liquid crystal display is selected from devices of conventionally known structures, such as transmission type, reflection type, or a transmission-reflection type. A liquid crystal cell to compose the liquid crystal display can be selected from appropriate cells of such as active matrix driving type represented by a thin film transistor, a simple matrix driving type represented by a twist nematic type and a super twist nematic type.

[0050]

When polarizing plates or optical members are arranged on both surfaces of a liquid crystal cell, the polarizing plates or the optical members on the surfaces can be the same or can be varied. Moreover, for forming a liquid crystal display, one or at least two layers of appropriate members such as a prism array sheet, a lens array sheet, an optical diffuser and a backlight can be arranged at proper positions.

[0051]

[Examples]

The present invention will be described below more specifically by referring to Examples and Comparative Examples.

[0052]

(Example 1)

A polarizer was obtained by dyeing a PVA film supplied by Kuraray Co., Ltd. (9 × 75RS) in a first bath (a 30°C aqueous solution containing both iodine and potassium iodine (KI)) while stretching to 3 times, further stretching in a second bath (a 55°C aqueous solution containing both boric acid and KI) so as to stretch the film to 6 times in total its original length. Later, the polarizer was adjusted to have moisture content of 6% by means of a dryer and a humidifier under controlled condition for temperature, humidity, air volume, and time. Subsequently, TAC films were bonded to a top and a bottom surface of the polarizer through a PVA-based adhesive in order to provide a polarizing plate.

[0053]

(Example 2)

A polarizer was obtained by dyeing a PVA film supplied by Kuraray Co., Ltd. (9 × 75RS) in a first bath (a 30°C aqueous solution containing both iodine and KI) while stretching to 3 times, further stretching in a second bath (a 55°C aqueous solution containing both boric acid and KI) so as to stretch the film to 6 times in total. Later, the polarizer was adjusted to have moisture content of 15% by means of a dryer and a humidifier under controlled conditions for temperature, humidity, air volume, and time. Subsequently, TAC films were bonded to both surfaces of the polarizer through a PVA-based adhesive in order to provide a polarizing plate.

[0054]

(Example 3)

A polarizer was obtained by dyeing a PVA film supplied by Kuraray Co., Ltd. (9 × 75RS) in a first bath (a 30°C aqueous solution containing both iodine and KI) while stretching to 3 times, further stretching in a second bath (a 55°C aqueous solution containing both boric acid and KI) so as to stretch the film to 6 times in total. Later, the polarizer was adjusted to have moisture content of 26% by means of a dryer and a humidifier under controlled conditions for temperature, humidity, air volume, and time. Subsequently, TAC films were bonded to both surfaces of the polarizer through a PVA-based adhesive in order to provide a polarizing plate.

[0055]

(Comparative Example 1)

A polarizer was obtained by dyeing a PVA film supplied by Kuraray Co., Ltd. (9 × 75RS) in a first bath (a 30°C aqueous solution containing both

iodine and KI) while stretching to 3 times, further stretching in a second bath (a 55°C aqueous solution containing both boric acid and KI) so as to stretch the film to 6 times in total. Later, the polarizer was adjusted to have moisture content of 4% by means of a dryer and a humidifier under controlled conditions for temperature, humidity, air volume, and time. Subsequently, TAC films were bonded to both surfaces of the polarizer through a PVA-based adhesive in order to provide a polarizing plate.

[0056]

(Comparative Example 2)

A polarizer was obtained by dyeing a PVA film supplied by Kuraray Co., Ltd. (9 × 75RS) in a first bath (a 30°C aqueous solution containing both iodine and KI) while stretching to 3 times, further stretching in a second bath (a 55°C aqueous solution containing both boric acid and KI) so as to stretch the film to 6 times in total. Later, the polarizer was adjusted to have moisture content of 35% by means of a dryer and a humidifier under controlled conditions for temperature, humidity, air volume, and time. Subsequently, TAC films were bonded to both surfaces of the polarizer through a PVA-based adhesive in order to provide a polarizing plate. In Comparative Example 2, however, irregularities occurred in the surfaces of the polarizing plate due to the drying treatment for bonding to the TAC film, because the moisture content was as high as 35%.

[0057]

The polarizing plates obtained in the Examples 1-3 and Comparative Examples 1-2 were evaluated. Optical properties to be measured were transmittance and a polarization degree for each plate. An instrument for measuring surface roughness shape (supplied by TOKYO SEIMITSU CO., LTD.) was used for measuring centerline average roughness (Ra) in a direction of the polarizing axis of the polarizing plate (a direction perpendicular to the stretching axis) and also mean spacing (Sm) of irregularities forming the streaks. Streaks were checked visually for the polarizing plates. The results are shown in Table 1.

[0058]

[Table 1]

	Polarizer	Polarizing plate				
	Moisture content (%)	Transmittance (%)	Polarization degree (%)	Surface roughness Ra (μm)	Surface roughness Sm (mm)	Visual observation
Com. Ex. 1	4	43.8	99.95	0.08	0.75	Prominent streaks
Example 1	6	43.8	99.95	0.03	1.81	Pale streaks
Example 2	15	43.8	99.94	0.01 or less	Unmeasurable	No streak
Example 3	26	43.8	99.94	0.01 or less	Unmeasurable	No streak
Com. Ex. 2	35	43.8	99.90	0.01 or less	Unmeasurable	No streak

Note: In Com. Ex. 2, while there was no streak but in-plane irregularity occurred.

*Com. Ex.: Comparative Example

[0059]

As indicated in Table 1, values of the centerline average roughness (Ra) for the polarizing plates (Examples 2-3) of the present invention were small, and the mean spacing of the irregularities (Sm) was unmeasurable. No streaks were recognized visually. Pale streaks recognized in the polarizing plate of Example 1 were not a substantial obstacle in use.

[0060]

For the polarizing plate of Comparative Example 1, which was produced under a condition of humidity out of the claimed range, the centerline average roughness (Ra) was remarkable and the mean spacing (Sm) was large. Moreover, streaks were recognized visually. The polarizing plate in Comparative Example 2 was good for the centerline average roughness (Ra) and the mean spacing (Sm). However, the polarization degree was inferior, and irregularities in the surface were recognized, resulting in inferior appearance.

[0061]

[Effects of the invention]

As mentioned above, the present invention provides a polarizing plate having improved appearance and also a liquid crystal display comprising the polarizing plate. In a method for producing the polarizing plate by bonding a protective layer on at least one surface of a polarizer, moisture content of the polarizer is limited to a range from 5% to 30% so that the protective layer would not have substantial irregularities like record grooves on the surface, which would be caused by stretching of the polarizing film. Such a polarizing plate can provide clear images even when reflected light is applied. Moreover, the method of the present invention can provide a polarizer having transmittance of at least 35% and a polarization degree of at least 90%.

[DOCUMENT NAME] ABSTRACT

[Abstract]

[Objects]

A polarizing plate produced according to the present invention includes a polarizing film and a protective layer bonded to a surface of the polarizing film, where the protective layer has no irregularities like record grooves caused by stretching of the polarizing film, so that the polarizing plate with an improved appearance provides clear images even when reflected light is applied.

[Means]

Such a polarizing plate is produced by laminating a protective layer on at least one surface of a polarizer having transmittance of at least 35% and a polarization degree of at least 90% while limiting moisture content of the polarizer to a range from 5% to 30%. A value for the moisture content is obtained by a calculation based on an equation of moisture content (%) = [(A – B) / B] × 100, when A denotes weight of the polarizer before bonding and B denotes weight of the polarizer after being kept in a dryer of 120°C for seven hours.

[Selected figure]

None

Historic Information on Applicant

Identification Number	[000003964]
1. Date of Change	August 31, 1990
[Reason for Change]	New registration
Address	1-2, Shimohozumi 1-chome, Ibaraki-shi, Osaka
Name	Nitto Denko Corporation

MARKED-UP COPY OF U.S. 09/981,614 SPECIFICATION

The present invention relates to the field of polarizing plates for a liquid crystal display (LCD) and a liquid crystal display using polarizing plates.

Recently, the use of LCDs in personal computers (PCs) or the like has increased sharply, and they have been used for monitors as well.

Typical polarizing plates used for display devices such as LCDs are produced from polyvinyl alcohol (PVA) films or the like. The PVA films are dyed with dichroic iodine or dichroic dyestuff, and then crosslinked with boric acid, borax or the like. The films are then be stretched uniaxially. The stretching step can be included in the dyeing and/or crosslinking steps. Alternatively, the film can be stretched before and/or after the dyeing and/or crosslinking steps. In general, the film is dried in a dryer or the like after the dyeing and crosslinking steps, and it is bonded to a protective layer such as a triacetylcellulose (TAC) film through an adhesive.

A polarizing plate used for a LCD is required to have high transmittance and a high polarization degree. For this purpose, a PVA film should be stretched at a high ratio. However, when a PVA film is stretched at a high stretch ratio, irregularities like grooves on a record may be generated on the polarizer surface, and this will impair the appearance. The irregularities can be recognized even through a protective film like a TAC film or a polyethylene terephthalate (PET) film bonded to the polarizer. As a result, images provided by the polarizing plate will be blurred when reflected light is applied.

The present invention provides a method of producing a polarizing plate having an improved appearance and also a liquid crystal display comprising the polarizing plate. In this context, "improved appearance" means that a protective layer of the polarizing plate substantially has no irregularities like grooves on a record caused by stretching of a polarizing film bonded to the protective layer. Such a polarizing plate can provide clear images even when reflected light is applied.

In a method of producing a polarizing plate according to the present invention, a protective layer is bonded to at least one surface of a polarizer so as to provide a polarizing plate having transmittance of at least 35% and a polarization degree of at least 90%. This method is characterized in that moisture content of the polarizer is in a range from 5% to 30% during a step

Deleted: More specifically, the present invention provides a method of producing a polarizing plate having an improved appearance and also a liquid crystal display comprising the polarizing plate. In this context, "improved appearance" means that a protective layer of the polarizing plate substantially has no irregularities like grooves on a record caused by stretching of a polarizing film bonded to the protective layer. Such a polarizing plate can provide clear images even when reflected light is applied.

Deleted: [0002]¶

Deleted: [0003]¶

Deleted: [0004]¶

Deleted: [0005]¶

Deleted: [0006]¶

Deleted: polarizer

that the protective layer is bonded to the polarizer. A measurement value is obtained by a calculation based on an equation of moisture content (%) = $[(A - B) / B] \times 100$, when A denotes weight of the polarizer before bonding and B denotes weight of the polarizer after being kept in a dryer of 120°C for seven hours.

When the moisture content is less than 5%, the polarizer becomes hard. This causes irregularities like record grooves on the surface, and a crosslinking agent tends to be deposited from the polarizer so as to deteriorate the appearance. Moisture content over 30% will cause some disadvantages such as adhesion failure when the polarizer is bonded to a protective layer such as a TAC film. Moreover, irregularities occur due to discoloring of iodine in the polarizing plate during a drying treatment subsequent to bonding of the TAC film. A further preferred range for the moisture content of the polarizer is from 9% to 27%.

The surface roughness of the polarizing plate in a direction perpendicular to the stretching direction plate is at most 0.04 μm on the basis of the centerline average roughness. When the roughness exceeds 0.04 μm, visual recognition of irregularities may be facilitated. That is, irregularities will be prominent. It is especially preferable that the surface roughness is not more than 0.01 μm, since no streaks will be recognized visually.

The surface roughness can be calculated in accordance with Japanese Industrial Standard (JIS) B 0601-1994.

Preferably, the polarizer is bonded to a protective layer through an adhesive layer, so that peeling of the protective layer from the polarizer can be prevented.

The polarizer is produced by stretching a hydrophilic polymer film while dyeing in a dye bath containing dichroic iodine or dichroic dyestuff, and then crosslinking in a crosslinking bath containing a crosslinking agent. A preferred example of such hydrophilic polymer films is a polyvinyl alcohol-based film from the aspect of the excellent dye-affinity.

In one embodiment, the polarizing plate can be either a reflective or a semitransparent reflective polarizing plate obtained by laminating either a reflecting plate or a semitransparent reflecting plate on any of the above-mentioned polarizing plates.

In one embodiment, the polarizing plate can be obtained by laminating a retardation plate (λ plate) on any of the above-mentioned

Deleted: (

Deleted:)

Deleted: ¶
[0007]¶

Deleted: [0008]¶

Deleted: [0009]¶
. In one embodiment, the polarizing plate can be either a reflective or a semitransparent reflective polarizing plate obtained by bonding either a reflecting plate or a semitransparent reflecting plate onto any of the above-mentioned polarizing plates.¶
[0010]¶
. In one embodiment, the polarizing plate can be obtained by bonding a retardation plate or a λ plate onto any of the above-mentioned polarizing plates so as to cope with either elliptically or circularly polarized light.¶
[0011]¶
In one embodiment, the polarizing plate

Deleted: bonding

polarizing plates so as to cope with either elliptically or circularly polarized light.

In one embodiment, the polarizing plate can be obtained by laminating a viewing-angle compensating film on any of the above-mentioned polarizing plates.

Deleted: to

In one embodiment, the polarizing plate can be obtained by laminating a brightness-enhanced film on any of the above-mentioned polarizing plates by using an adhesive or a pressure-sensitive adhesive.

Deleted: [0012]¶

Deleted: bonding

Deleted: onto

A liquid crystal display according to the present invention comprises a liquid crystal cell and a polarizing plate prepared in the above-mentioned process, and the polarizing plate is provided to at least one surface of the liquid crystal cell.

Deleted: [0013]¶

According to a method of producing a polarizing plate, a polarizer having a polarizing function is obtained by subjecting a PVA film to respective steps such as swelling, dyeing, stretching, crosslinking and drying. Later, the polarizer is bonded to a protective film of TAC, PET or the like through an adhesive or a pressure-sensitive adhesive so as to provide a polarizing plate.

Deleted: [0014]¶

There is no specific limitation on the order of four steps of swelling, dyeing, stretching and crosslinking. Some or all of the four steps can be performed simultaneously.

Deleted: [0015]¶

In the present invention, irregularities like record grooves on the polarizer or on the polarizing plate can substantially be prevented by limiting the moisture content of the polarizer in a range from 5% to 30% during a step of bonding the polarizer and the protective layer.

Deleted: [0016]¶

Generally, a polarizer of a PVA film, which is processed through steps including swelling, dyeing, stretching, crosslinking and drying, is wound into a roll for the following steps. Such a polarizer can be produced in a continuous series of steps including adjustment of the moisture content of the polarizer by humidification or the like, before bonding the polarizer to a protective layer such as a TAC film.

Deleted: [0017]¶

A typical process of producing a polarizing film comprises three steps of dyeing, crosslinking and stretching. In a dyeing step, a PVA film is dyed in a bath containing dichroic iodine or dyestuff. In a crosslinking step, the film is crosslinked in a bath containing a PVA-crosslinking agent such as boric acid and borax. In a stretching step, the PVA film is stretched. Stretching is often performed simultaneously with the dyeing and

Deleted: [0018]¶

crosslinking steps, but it can be carried out separately. Alternatively, the dyeing step and the crosslinking step can be performed at the same time. Subsequent to the three steps, the PVA film is dried and then, a protective layer such as a TAC film or a PET film is bonded to at least one surface of the PVA film.

In one embodiment, a polarizer (polarizing film) is prepared from a conventional hydrophilic polymer film comprising a suitable vinyl alcohol-based polymer such as polyvinyl alcohol and partially formalized polyvinyl alcohol. The film is treated in a suitable order and a suitable process, for example, dyeing with a dichroic substance selected from, e.g., iodine and dichroic dyestuff, stretching and crosslinking. A preferable polarizer will transmit linearly polarized light when natural light enters. It is more preferable that the polarizer has excellent optical transmittance and polarization degree.

Deleted: [0019]¶

A polarizing plate having high transmittance and a high polarization degree can comprise a polarizer (polarizing film) that is prepared by stretching a hydrophilic polymer film or the like having a thickness in a range from 10 μm to 200 μm, or preferably from 30 μm to 80 μm, in a total stretch ratio ranging from 4 to 7 times the original length, or preferably from 5 to 6.5 times. When the stretch ratio is less than 4, the obtained polarizer would not have a sufficient polarization degree. When the total stretch ratio exceeds 7, the film tends to break during stretching, so that stable supply of polarizing films will be prevented. A hydrophilic polymer film having a thickness of less than 10 μm is difficult to stretch because the film tends to break, while a hydrophilic polymer film having a thickness of more than 200 μm is difficult to dry during film-formation and thus, problems such as foaming will occur easily. Specifically, it is difficult to dry such a thick film uniformly, and a film that is not dried uniformly may cause swelling and dye-irregularities in manufacturing the polarizing film.

Deleted: [0020]¶

Any appropriate transparent film can be used for a protective film to form a transparent protective layer on at least one surface of a polarizer (polarizing film). One typical and non-limiting example of polymers for the protective film is an acetate-based resin such as triacetylcellulose. Examples of alternative polymers include transparent films of resins based on polycarbonate, polynorbornene, polyesters such as PET, polyether sulfone, polyamide, polyimide, polyolefins such as polyethylene, polystyrene, and acrylic substances, or films of resins that will be cured by heat or ultraviolet

rays, based on acrylic substances, urethane, acrylic urethane, epoxy, and silicones.

A transparent protective film preferred especially from the aspect of polarizing characteristics and durability is a TAC film having a surface saponified with an alkali substance or the like. Transparent protective films formed on both surfaces of a polarizing film are not necessarily made of identical polymers.

Deleted: [0021]¶

A transparent protective film used for the protective layer can be treated to provide properties such as hard coating, antireflection, anti-sticking, diffusion and anti-glaring, as long as the purposes of the present invention are not sacrificed. Hard coating treatment is applied, for example, to prevent scratches on the surfaces of the polarizing plate. A surface of the transparent protective film can be applied with a coating film of a cured resin with excellent hardness and smoothness, e.g., a silicone-based ultraviolet-cure type resin.

Deleted: [0022]¶

Antireflection treatment may be applied to prevent reflection of outdoor daylight on the surface of the polarizing plate. Such an anti-reflection film or the like can be formed in a known method. Anti-sticking treatment is applied to prevent adherence of adjacent layers. Anti-glare treatment is applied to prevent visibility of light transmitted through the polarizing plate from being hindered by outdoor daylight reflected on the polarizing plate surface. Anti-glare treatment can be carried out by providing microscopic asperity on a surface of a transparent protective film in an appropriate manner, e.g., by roughening the surface by sand-blasting or embossing, or by blending transparent particles.

Deleted: [0023]¶

The above-mentioned transparent fine particles will be selected from silica, alumina, titania, zirconia, stannic oxide, indium oxide, cadmium oxide, antimony oxide or the like, and the particles have an average diameter ranging from 0.5 μm to 20 μm. Inorganic fine particles having electroconductivity can be used as well. Alternatively, the particles can be organic fine particles comprising, for example, crosslinked or uncrosslinked polymer particles. An amount of the transparent fine particles ranges from 2 weight parts to 70 weight parts, and generally, from 5 weight parts to 50 weight parts, for 100 weight parts of a transparent resin.

Deleted: [0024]¶

An anti-glare layer comprising transparent fine particles can be provided as the transparent protective layer or a coating layer applied onto a transparent protective layer surface. The anti-glare layer can function as

Deleted: [0025]¶

a diffusion layer to diffuse light transmitted through the polarizing plate in order to enlarge visual angles (this function is denoted as visual angle compensation). The above-mentioned layers such as the antireflection layer, the anti-sticking layer, the diffusion layer and the anti-glare layer can be provided as an sheet of optical layers comprising these layers separately from the transparent protective layer.

There is no specific limitation on a method to adhere the polarizer (polarizing film) and the transparent protective film. Adhesion can be applied, for example, by using adhesives such as an adhesive comprising vinyl alcohol-based polymer, or an adhesive comprising at least the vinyl alcohol-based polymer and a water-soluble agent to crosslink the vinyl alcohol-based polymer, such as boric acid, borax, glutaraldehyde, melamine and oxalic acid. A polyvinyl alcohol-based adhesive is preferred especially since it has the best adherence with polyvinyl alcohol-based films. Such an adhesive layer is formed by, for example, applying and drying an aqueous solution, and an additive or a catalyst such as an acid can be blended in preparation of the aqueous solution if required.

Deleted: [0026]¶

A polarizing plate of the present invention can be laminated with another optical layer in order to be used as an optical member. Though there is no specific limitation on the optical layer, one or more suitable optical layer applicable for formation of a liquid crystal display can be used, and the optical layer can be selected from, for example, a reflecting plate, a semitransparent reflecting plate, a retardation plate such as a λ plate like a half wavelength plate and a quarter wavelength plate, a viewing angle compensating film, and a brightness-enhanced film. In a preferred embodiment, a reflective polarizing plate or a semitransparent reflective polarizing plate formed by laminating an additional reflecting plate or a semitransparent reflecting plate on the above-mentioned polarizing plate comprising a polarizer and a protective layer according to the present invention; a polarizing plate formed by laminating an additional retardation plate on the above-mentioned polarizing plate comprising a polarizer and a protective layer; a polarizing plate having a viewing angle compensating film laminated additionally on the above-mentioned polarizing plate comprising a polarizer and a protective layer; and a polarizing plate having a brightness-enhanced film laminated additionally on the above-mentioned polarizing plate comprising a polarizer and a protective layer is used.

Deleted: [0027]¶

A reflecting plate is provided to a polarizing plate in order to form a

Deleted: [0028]¶

reflective polarizing plate. In general, such a reflective polarizing plate is arranged on a backside of a liquid crystal cell in order to make a liquid crystal display to reflect incident light from a visible side (display side). The reflective polarizing plate has some merits, for example, assembling of light sources such as backlight can be omitted, and the liquid crystal display can be thinned further.

The reflective polarizing plate can be formed in an appropriate manner such as attaching a reflecting layer of metal or the like on one surface of the polarizing plate. For example, a transparent protective film is prepared by matting one of the surfaces if required. On this surface, a foil comprising a reflective metal such as aluminum or a deposition film is applied to form a reflecting layer.

Deleted: [0029]¶

An additional example of a reflective polarizing plate comprises the above-mentioned transparent protective film having a surface of a microscopic asperity due to contained fine particles, and also a reflecting layer corresponding to the microscopic asperity. The reflecting layer having a microscopic asperity surface diffuses incident light irregularly so that directivity and glare can be prevented and irregularity in color tones can be controlled. This transparent protective film can be formed by attaching a metal directly on a surface of a transparent protective film in any appropriate methods including deposition such as vacuum deposition, and plating such as ion plating and sputtering.

Deleted: [0030]¶

Alternatively, the reflecting plate can be used as a reflecting sheet formed by providing a reflecting layer onto a proper film similar to the transparent protective film. Since a typical reflecting layer of a reflecting plate is made of a metal, it is used preferably in a state coated with a film, a polarizing plate or the like in order to prevent the reflection rate from reduction due to oxidation. As a result, the initial reflection rate is maintained for a long period, and a separate protective layer can be omitted.

Deleted: [0031]¶

A semitransparent polarizing plate is provided by replacing the reflecting layer in the above-mentioned reflective polarizing plate by a semitransparent reflecting layer, and it is exemplified by a half mirror that reflects and transmits light at the reflecting layer. In general, such a semitransparent polarizing plate is arranged on a backside of a liquid crystal cell. In a liquid crystal display comprising the semitransparent polarizing plate, incident light from the visible side (display side) is reflected to display an image when a liquid crystal display is used in a relatively

Deleted: [0032]¶

bright atmosphere, while in a relatively dark atmosphere, an image is displayed by using a built-in light source such as a backlight in the backside of the semitransparent polarizing plate. In other words, the semitransparent polarizing plate can be used to form a liquid crystal display that can save energy for a light source such as a backlight under a bright atmosphere, while a built-in light source can be used under a relatively dark atmosphere.

Deleted: [0033]¶

The above-mentioned polarizing plate comprising a polarizer and a protective layer can have an additional laminate of a retardation plate.

Deleted: [0034]¶

The retardation plate is used for modifying linearly polarized light to either elliptically polarized light or circularly polarized light, modifying either elliptically polarized light or circularly polarized light to linearly polarized light, or modifying a polarization direction of linearly polarized light. For example, a retardation plate called a quarter wavelength plate ($\lambda/4$ plate) is used for modifying linearly polarized light to either elliptically polarized light or circularly polarized light, and for modifying either elliptically polarized light or circularly polarized light to linearly polarized light. A half wavelength plate ($\lambda/2$ plate) is used in general for modifying a polarization direction of linearly polarized light.

Deleted: [0035]¶

The above-described polarizing plate concerning elliptical polarized light is effective in compensating (preventing) colors (blue or yellow) generated due to birefringence in a liquid crystal layer of a super twist nematic (STN) liquid crystal display so as to provide a black-and-white display free of such colors. Controlling three-dimensional refractive index is preferred further since it can compensate (prevent) colors that will be observed when looking a screen of the liquid crystal display from an oblique direction. A polarizing plate concerning circularly polarized light is effective in adjusting color tones of an image of a reflective liquid crystal display that has a color image display, and the polarizing plate serves to prevent reflection as well.

Deleted: [0036]¶

Specific examples of the retardation plates include birefringent films, oriented films of liquid crystal polymers, sheets comprising film and oriented layers supported by the films, and incline-oriented films. The birefringent films can be prepared by stretching films of any suitable liquid crystal polymers such as polycarbonate, polyvinyl alcohol, polystyrene, polymethyl methacrylate, polyolefins including polypropylene, polyalylate, and polyamide. An incline-oriented film is produced, for example, by

bonding a heat shrinkable film onto a polymer film and stretching and/or shrinking the polymer film under an influence of the shrinking force provided by heat, or by orienting obliquely a liquid crystal polymer.

A polarizing plate described below comprises the above-mentioned polarizer and protective layer, and further an additional viewing angle compensating film laminated on the polarizing plate.

Deleted: [0037]¶

A viewing angle compensating film is used for widen an visual angle so that an image can be clear relatively when a screen of a liquid crystal display is seen not in a direction perpendicular to the screen but in a slightly oblique direction.

Deleted: [0038]¶

Such a viewing angle compensating film can be a triacetylcellulose film coated with a discotic liquid crystal, or a retardation plate. While an ordinary retardation plate is a birefringent polymer film that is stretched uniaxially in the face direction, a retardation plate used for an viewing angle compensating film is a two-way stretched film such as a birefringent polymer film stretched biaxially in the face direction and an incline-oriented polymer film with controlled birefringence in the thickness direction that is stretched uniaxially in the face direction and stretched also in the thickness direction. The incline-oriented film is prepared by, for example, bonding a heat shrinkable film to a polymer film and stretching and/or shrinking the polymer film under an influence of shrinkage force provided by heat, or by orienting obliquely a liquid crystal polymer. A polymer as a material of the retardation plate is similar to the polymer used for the above-mentioned retardation plate.

Deleted: [0039]¶

A polarizing plate described below is produced by laminating a brightness-enhanced film additionally on the above-mentioned polarizing plate comprising a polarizer and a protective layer. Generally, this polarizing plate is arranged on a backside of a liquid crystal cell. When natural light enters, by reflection from a backlight or a backside of a liquid crystal display etc., the brightness-enhanced film reflects linearly polarized light of a predetermined polarizing axis or circularly polarized light in a predetermined direction while the same film transmits other light. It allows entrance of light from a light source such as a backlight so as to obtain transmitted light in a predetermined polarization state, while reflecting light other than light in the predetermined polarization state. Light that is reflected at this brightness-enhanced film is reversed through a reflecting layer or the like arranged additionally behind the

Deleted: [0040]¶

brightness-enhanced film. The reversed light that re-enters the brightness-enhanced plate is transmitted partly or entirely as light in a predetermined polarization state, so that light transmitting the brightness-enhanced film is increased and polarized light that is hardly absorbed in the polarizer is supplied. As a result, quantity of light available for the liquid crystal display etc. can be increased to enhance brightness. When light enters through a polarizer from the backside of a liquid crystal cell by using a backlight or the like without using any brightness-enhanced films, most light is absorbed in the polarizer but not transmitted the polarizer if the light has a polarization direction inconsistent with the polarization axis of the polarizer. Depending on characteristics of the polarizer, about 50% of light is absorbed in the polarizer, and this decreases quantity of light available in the liquid crystal display or the like and makes the image dark. The brightness-enhanced film repeatedly prevents light having a polarization direction to be absorbed in the polarizer from entering the polarizer, and reflects the light on the brightness-enhanced film, reverses the light through a reflecting layer or the like arranged behind, and makes the light re-enter the brightness-enhanced plate. Since the polarized light that is reflected and reversed between them is transmitted only if the light has a polarization direction to pass the polarizer, light from a backlight or the like can be used efficiently for displaying images of a liquid crystal display in order to provide a bright screen.

A suitable example of the brightness-enhanced film is selected from a multilayer thin film of a dielectric or a multilayer lamination of thin films with varied refraction aeolotropy (e.g., "D-BEF" supplied by 3M Co.) that transmits linearly polarized light having a predetermined polarization axis while reflecting other light, and a cholesteric liquid crystal layer, more specifically, an oriented film of a cholesteric liquid crystal polymer or an oriented liquid crystal layer fixed onto a supportive substrate (e.g., "PCF 350" supplied by Nitto Denko Corporation; "Transmax" supplied by Merck and Co., Inc.) that reflects either clockwise or counterclockwise circularly polarized light while transmitting other light.

Deleted: [0041]¶

Therefore, for a brightness-enhanced film to transmit linearly polarized light having a predetermined polarization axis, the transmission light enters the polarizing plate by matching the polarization axis so that absorption loss due to the polarizing plate is controlled and the light can be

Deleted: [0042]¶

transmitted efficiently. For a brightness-enhanced film to transmit circularly polarized light, i.e., a cholesteric liquid crystal layer, preferably, the transmission circularly polarized light is converted to linearly polarized light before entering the polarizing plate in an aspect of controlling of the absorption loss, though the circularly polarized light can enter the polarizer directly. Circularly polarized light can be converted to linearly polarized light by using a quarter wavelength plate for a retardation plate.

A retardation plate having a function as a quarter wavelength plate in a wide wave range including a visible light region can be obtained, for example, by overlapping a retardation layer functioning as a quarter wavelength plate for monochromatic light such as light having 550 nm wavelength and another retardation plate showing a separate optical retardation property (e.g., a retardation plate functioning as a half wavelength plate). Therefore, a retardation plate arranged between a polarizing plate and a brightness-enhanced film can comprise a single layer or at least two layers of retardation layers.

Deleted: [0043]¶

A cholesteric liquid crystal layer also can be provided by combining layers different in the reflection wavelength and it can be configured by overlapping two or at least three layers. As a result, the obtained retardation plate can reflect circularly polarized light in a wide wavelength range including a visible light region, and this can provide transmission circularly polarized light in a wide wavelength range.

Deleted: [0044]¶

A polarizing plate according to the present invention can be made by laminating a polarizing plate and two or at least three optical layers, similarly to the above-described polarization-separation type polarizing plates. In other words, the polarizing plate can be a reflective polarizing plate or a semitransparent polarizing plate for elliptically polarized light, which is prepared by combining either the above-mentioned reflective polarizing plate or a semitransparent polarizing plate with a retardation plate. An optical member comprising a lamination of two or at least three optical layers can be formed in a method of laminating layers separately in a certain order for manufacturing a liquid crystal display etc. Since an optical member that has been laminated previously has excellent stability in quality and assembling operability, efficiency in manufacturing a liquid crystal display can be improved. Any appropriate adhesion means such as a pressure-sensitive adhesive can be used for laminating the polarizing plate and optical layers.

Deleted: [0045]¶

A pressure-sensitive adhesive layer can be provided to a polarizing plate or to an optical member in the present invention for adhesion with other members such as a liquid crystal cell. The pressure-sensitive adhesive layer can contain any suitable pressure-sensitive adhesives such as an acrylic adhesive in accordance with conventional techniques. Particularly, pressure-sensitive adhesive layers having a low moisture absorption coefficient and an excellent heat resistance is preferred from the aspect of prevention of foaming or peeling caused by moisture absorption or prevention of decrease in the optical properties and warping of a liquid crystal cell caused by difference in thermal expansion coefficients. As a result, a high quality liquid crystal display having excellent durability can be produced. The pressure-sensitive adhesive layer can include fine particles to obtain optical diffusivity. Pressure-sensitive adhesive layers can be provided to appropriate surfaces if required. For example, a polarizing plate comprising a polarizer and a protective layer can be provided with a pressure-sensitive adhesive layer on at least one surface of the protective layer.

Deleted: [0046]¶

When a pressure-sensitive adhesive layer is exposed on a surface of the polarizing plate or the optical member, preferably, the pressure-sensitive adhesive layer is covered with a separator by the time the pressure-sensitive adhesive layer is used so that contamination will be prevented. The separator can be made of an appropriate thin sheet by coating a peeling agent if required, and the peeling agent may be selected, for example, from a silicone-based agent, a long-chain alkyl-based agent, a fluorine-based agent, an agent comprising molybdenum sulfide or the like.

Deleted: [0047]¶

The above-described members composing a polarizing plate and an optical member, such as a polarizer, a transparent protective film, an optical layer and a pressure-sensitive adhesive layer, can have ultraviolet absorption power as a result of treatment with an ultraviolet absorber such as an ester salicylate compound, a benzophenone compound, a benzotriazole compound, a cyanoacrylate compound, and a nickel complex salt compound.

Deleted: [0048]¶

Polarizing plates according to the present invention can be used preferably for forming various devices such as LCDs. Such a polarizing plate is arranged on at least one surface of a liquid crystal cell in order to form various devices such as a liquid crystal display. The liquid crystal display is selected from devices of conventionally known structures, such as transmission type, reflection type, or a transmission-reflection type. A

Deleted: [0049]¶

liquid crystal cell to compose the liquid crystal display can be selected from appropriate cells of such as active matrix driving type represented by a thin film transistor, a simple matrix driving type represented by a twist nematic type and a super twist nematic type.

When polarizing plates or optical members are arranged on both surfaces of a liquid crystal cell, the polarizing plates or the optical members on the surfaces can be the same or can be varied. Moreover, for forming a liquid crystal display, one or at least two layers of appropriate members such as a prism array sheet, a lens array sheet, an optical diffuser and a backlight can be arranged at proper positions.

Deleted: [0050]¶

The present invention will be described below more specifically by referring to Examples and Comparative Examples.

Deleted: [0051]¶

(Example 1)

Deleted: [0052]¶

A polarizer was obtained by dyeing a PVA film supplied by Kuraray Co., Ltd. (9X75RS, having a polymerization degree of 2400 and a thickness of 75 μm) in a first bath (a 30°C aqueous solution containing both iodine and potassium iodine (KI)) while stretching to 3 times, further stretching in a second bath (a 55°C aqueous solution containing both boric acid and KI) so as to stretch the film to 6 times in total its original length. Later, the polarizer was adjusted to have moisture content of 6% by means of a dryer and a humidifier under controlled condition for temperature, humidity, air volume, and time. Subsequently, TAC films were bonded to a top and a bottom surface of the polarizer through a PVA-based adhesive in order to provide a polarizing plate. A value for the moisture content is obtained by a calculation based on an equation of moisture content (%) = [(A – B) / B] × 100, when A denotes weight of the polarizer before bonding and B denotes weight of the polarizer after being kept in a dryer of 120°C for seven hours.

Deleted: 9 × 75RS

(Example 2)

Deleted: [0053]¶

A polarizer was obtained by dyeing a PVA film supplied by Kuraray Co., Ltd. (9X75RS) in a first bath (a 30°C aqueous solution containing both iodine and KI) while stretching to 3 times, further stretching in a second bath (a 55°C aqueous solution containing both boric acid and KI) so as to stretch the film to 6 times in total. Later, the polarizer was adjusted to have moisture content of 15% by means of a dryer and a humidifier under controlled conditions for temperature, humidity, air volume, and time. Subsequently, TAC films were bonded to both surfaces of the polarizer through a PVA-based adhesive in order to provide a polarizing plate.

Deleted: 9 ×

(Example 3)

A polarizer was obtained by dyeing a PVA film supplied by Kuraray Co., Ltd. (9X75RS) in a first bath (a 30°C aqueous solution containing both iodine and KI) while stretching to 3 times, further stretching in a second bath (a 55°C aqueous solution containing both boric acid and KI) so as to stretch the film to 6 times in total. Later, the polarizer was adjusted to have moisture content of 26% by means of a dryer and a humidifier under controlled conditions for temperature, humidity, air volume, and time. Subsequently, TAC films were bonded to both surfaces of the polarizer through a PVA-based adhesive in order to provide a polarizing plate.

(Comparative Example 1)

A polarizer was obtained by dyeing a PVA film supplied by Kuraray Co., Ltd. (9X75RS) in a first bath (a 30°C aqueous solution containing both iodine and KI) while stretching to 3 times, further stretching in a second bath (a 55°C aqueous solution containing both boric acid and KI) so as to stretch the film to 6 times in total. Later, the polarizer was adjusted to have moisture content of 4% by means of a dryer and a humidifier under controlled conditions for temperature, humidity, air volume, and time. Subsequently, TAC films were bonded to both surfaces of the polarizer through a PVA-based adhesive in order to provide a polarizing plate.

(Comparative Example 2)

A polarizer was obtained by dyeing a PVA film supplied by Kuraray Co., Ltd. (9X75RS) in a first bath (a 30°C aqueous solution containing both iodine and KI) while stretching to 3 times, further stretching in a second bath (a 55°C aqueous solution containing both boric acid and KI) so as to stretch the film to 6 times in total. Later, the polarizer was adjusted to have moisture content of 35% by means of a dryer and a humidifier under controlled conditions for temperature, humidity, air volume, and time. Subsequently, TAC films were bonded to both surfaces of the polarizer through a PVA-based adhesive in order to provide a polarizing plate. In Comparative Example 2, however, irregularities occurred in the surfaces of the polarizing plate due to the drying treatment for bonding to the TAC film, because the moisture content was as high as 35%.

The polarizing plates obtained in the Examples 1-3 and Comparative Examples 1-2 were evaluated. Optical properties to be measured were transmittance and a polarization degree for each plate. An instrument for measuring surface roughness shape (SURFCOM 470A supplied by TOKYO

Deleted: [0054]¶

Deleted: 9 ×

Deleted: [0055]¶

Deleted: 9 ×

Deleted: [0056] ¶

Deleted: 9 ×

Deleted: [0057]¶

SEIMITSU CO., LTD.) was used for measuring centerline average roughness (Ra) in a direction of the polarizing axis of the polarizing plate (a direction perpendicular to the stretching axis) and also mean spacing (Sm) of irregularities forming the streaks. Streaks were checked visually for the polarizing plates. The results are shown in Table 1.

Deleted: [0058]¶
¶
¶
¶
¶
¶
[

Table 1

Deleted:]

	Polarizer	Polarizing plate				
	Moisture content (%)	Transmittance (%)	Polarization degree (%)	Surface roughness Ra (μm)	Surface roughness Sm (mm)	Visual observation
Com. Ex. 1	4	43.8	99.95	0.08	0.75	Prominent streaks
Example 1	6	43.8	99.95	0.03	1.81	Pale streaks
Example 2	15	43.8	99.94	0.01 or less	Unmeasurable	No streak
Example 3	26	43.8	99.94	0.01 or less	Unmeasurable	No streak
Com. Ex.	35	43.8	99.90	0.01 or less	Unmeasurable	No streak

Deleted: 2

*Com. Ex.:Comparative Example

Deleted: Note: In

Deleted: 2, while there was no streak but in-plane irregularity occurred.¶
*Com. Ex.:

As indicated in Table 1, values of the centerline average roughness (Ra) for the polarizing plates (Examples 2-3) of the present invention were small, and the mean spacing of the irregularities (Sm) was unmeasurable. No streaks were recognized visually. Pale streaks recognized in the polarizing plate of Example 1 were not a substantial obstacle in use.

Deleted: [0059]¶

Deleted: [0060]¶

For the polarizing plate of Comparative Example 1, which was produced under a condition of humidity out of the claimed range, the centerline average roughness (Ra) was remarkable and the mean spacing (Sm) was large. Moreover, streaks were recognized visually. The polarizing plate in Comparative Example 2 was good for the centerline average roughness (Ra) and the mean spacing (Sm). However, the polarization degree was inferior, and irregularities in the surface were recognized, resulting in inferior appearance.

Deleted: [0061]¶

As mentioned above, the present invention provides a polarizing plate having improved appearance and also a liquid crystal display comprising the polarizing plate. In a method for producing the polarizing plate by bonding a protective layer on at least one surface of a polarizer, moisture content of the polarizer is limited to a range from 5% to 30% so that the protective layer would not have substantial irregularities like record grooves on the surface, which would be caused by stretching of the polarizing film. Such a polarizing plate can provide clear images even when reflected light is applied. Moreover, the method of the present invention can provide a polarizing plate having transmittance of at least 35% and a polarization degree of at least 90%.

Deleted: polarizer

The invention may be embodied in other forms without departing from the spirit or essential characteristics thereof. The embodiments

disclosed in this application are to be considered in all respects as illustrative and not limiting. The scope of the invention is indicated by the appended claims rather than by the foregoing description, all changes that come within the meaning and range of equivalency of the claims are intended to be embraced therein.